

# SCIENTIFIC AMERICAN

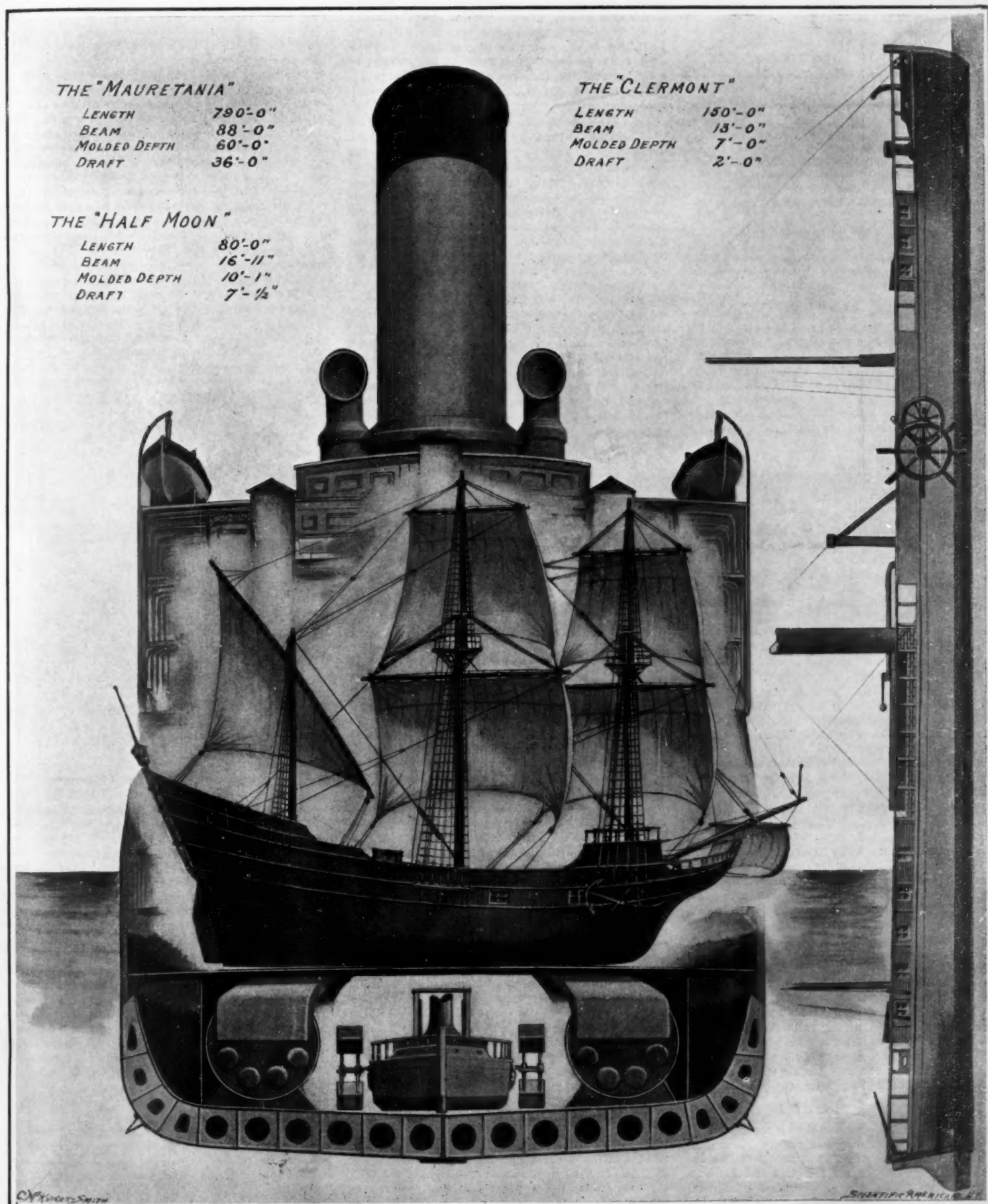
[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1909, by Munn & Co., Inc.]

A POPULAR ILLUSTRATED WEEKLY OF THE WORLD'S PROGRESS

Vol. CL—No. 13.  
ESTABLISHED 1845.

NEW YORK, SEPTEMBER 25, 1909.

[10 CENTS A COPY  
\$3.00 A YEAR.]



The "Half Moon" of 1609 under favorable circumstances could sail, probably, about 6 knots an hour. The "Clermont" of 1807 made 4½ knots. The "Mauretania" has crossed the Atlantic in 1909 at an average speed of 26 knots. The "Mauretania" could accommodate five "Clermonts" placed end to end on her boiler and engine room floor; and the "Half Moon" could be placed athwartship on the deck above, with her hull and masts entirely within the ship's structure.

Copyright 1909 by Munn & Co.

THREE CENTURIES OF NAVIGATION—1609 TO 1909.

## SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN &amp; CO., Inc., Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

CHARLES ALLEN MUNN, President  
361 Broadway, New York.FREDERICK CONVERSE BEACH, Sec'y and Treas.  
361 Broadway, New York.

## TERMS TO SUBSCRIBERS.

One copy, one year, for the United States or Mexico ..... \$1.00  
 One copy, one year, for Canada ..... 3.75  
 One copy, one year, to any foreign country, postage prepaid, 18s. 6d. 4.30

## THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (established 1845) ..... \$3.00 a year  
 Scientific American Supplement (established 1876) ..... 5.00 "  
 American Homes and Gardens ..... 3.00 "  
 Scientific American Export Edition (established 1878) ..... 3.00 "

The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.

Remit by postal or express money order, or by bank draft or check.

MUNN & CO., Inc., 361 Broadway, New York.

NEW YORK, SATURDAY, SEPTEMBER 25th, 1909.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

## THE "WASH" OF AN AEROPLANE.

Those of our readers who have sat in a racing shell, or stood at the wheel of a racing yacht, will remember how troublesome is the "wake" of a competitor, whether it takes the form of the wash of his sculls, or of the disturbance of the air as it sweeps from the leach of the mainsail of a weatherly yacht that is cutting out to windward some distance ahead. In the case of two racing yachts that are thrashing it out on the same tack in a struggle to windward, there is a certain relative position of the two, in which the disturbance of the air, caused by its passage over the sails of the leading yacht, will prove exceedingly troublesome to the second boat, especially if she be but a few lengths astern and sailing close to the wake of the other. When this occurs, there is nothing for it but to put on the other tack, and so get clear of the interference.

With the rapid development of mechanical flight, the remarkable extent of which was shown so clearly in the recent brilliant performances at Rheims, it has become evident that the "wash," or interference, which is inconvenient to a sailing yacht, may become positively disastrous to that yacht of the air, the aeroplane. It was not until the Rheims contests that an opportunity was presented to determine the effect of one aeroplane upon another, when, in meeting or overtaking, they passed in rather close proximity. It is quite possible that the question of interference had never occurred to the aviators at Rheims, but it is certainly a surprising fact that the existence of such interference, and its evidently serious character as shown when several machines were in the air at once, should not have excited more attention, both at the time and in subsequent expert discussions of the Rheims contests.

When such a large body as an aeroplane, spreading several hundred square feet of surface, and weighing from a quarter to half a ton, is driven at fifty miles an hour by propellers that are revolving at from 1,000 to 1,200 revolutions per minute, it is certain to leave in its wake a complicated series of aerial cross currents, whirlpools, and vortices. Now, judging from the description of eyewitnesses of the Rheims races, the behavior of the aeroplanes, when they swept into rather close proximity to one another, indicates that these artificially-created wind storms were present, and that they seriously affected the equilibrium of any aeroplane that came within their influence. The "wash" from propellers, driven, as in the case of Blériot's monoplane, by an 80-horse-power engine, and the air waves set up by the passage of his planes must be very serious indeed; certainly the air will not regain its equilibrium until long after the machine has swept by.

Two notable instances of this interference occurred when several aeroplanes were in the air together. During one race, when Farman was rapidly overhauling opponents who were flying at the same level, he encountered the "wash" of the machines and his own aeroplane was thrown into rather violent oscillation. Before he could pass, it was necessary to make a wide detour to the right or left, or swing up to a higher level into undisturbed air. On another occasion when Latham, flying high, overtook a competitor who was traveling at a lower level it was noticed that his own aeroplane made a sudden dive, as though drawn

downward by the suction of the machine below him.

We attach no little importance to a question which must become increasingly serious as the number of flying machines is multiplied, and the favorite lines of travel become populous with these mechanical birds of the air. "Leeway," as the sailors call it, will become even more necessary to the air yacht than it is now to the sailing yacht. Woe to the aviator who, flying low with scant clearance between himself and the ground, is overtaken by some aeronautical scorcher, who sweeps up from behind, and with the characteristic snort of triumph whirls onward, giving him his aerial dust. Happy for him if he recover his rudely-disturbed equilibrium at the expense of a broken wing and not of a broken neck. Perhaps after all we have been a little too "previous" in felicitating ourselves upon the unlimited room that will be afforded for flight through the air; evidently the clearance demanded by our sixty-mile-an-hour aeroplane must be measured by something far wider than the stretch from tip to tip of the planes, or the length from head to tail.

## THE RETURN OF HALLEY'S COMET.

The announcement by Prof. Max Wolf that he has discovered Halley's comet will be received with interest and with surprise by every astronomer throughout the world—with interest, because not a little credit redounds to the Heidelberg astronomer, when it is considered how much this honor has been coveted; and with surprise, because the historic comet has made its appearance nearly four months before it was expected.

Halley's comet is unique because it was the first celestial body of its kind which was mathematically subjugated to the law of gravitation, and because its history is to a large extent the history of astronomy. In 1682 a comet was observed by Newton, Halley, and others. On examining the circumstances of its motion, Edmund Halley, who was Newton's intimate friend, and who did perhaps more than any other astronomer of his day to popularize the idea of gravitation, computed its orbit on the supposition that it was parabolic. Comparing his results with the observations of previous comets, for which purpose it was necessary to calculate their orbits from the necessarily imperfect measurements of earlier times, he found that in 1531 and 1607 comets had appeared which followed so nearly the same path that he ventured to assert its identity with them, and to predict its return within a period of about 75 years. Knowing that he would not live to witness the event, because of his advanced age, he left a plea for recognition which reads: "Wherefore, if it should return according to our predictions about the year 1758, impartial posterity will not refuse to acknowledge that this was first discovered by an Englishman."

In the year 1758 the French astronomer Clairaut took up the task of computing the perturbations which the comet would probably have experienced since its last appearance, because of the influence of the two great planets, Jupiter and Saturn. An extremely laborious calculation showed that the comet would have been retarded about 100 days by Saturn and about 518 days by Jupiter; and accordingly he announced to the Academy of Sciences near the end of the year 1758, that the comet might be expected to pass its perihelion about April 13th of the following year, and that owing to various defects in this calculation, there might be an error of a month either way. The comet was actually discovered by an amateur, George Palitzsch, on Christmas day, 1758, thereby justifying Halley's brilliant conjecture, adding a new member to the solar system, and raising the hope (to be later amply fulfilled) that in other cases also the motions of comets might be reduced to rule. Thus at one fell stroke the dreadful divinity that once hedged a comet, the badge of pestilence, of war, and of death, was swept aside for all time.

Since Clairaut's day Halley's comet has been made the subject of much mathematical inquiry. The French astronomer Pontécoulant carried the calculation of the perturbations back to 1531, and recently Messrs. Cowell and Crommelin of Greenwich have traced the comet back beyond the Christian era. The result of these computations has been to prove that Halley's comet undoubtedly appeared in 1066, and was promptly regarded by William the Conqueror as an omen of victory for his English invasion, and that it is the same which is depicted on the Bayeux tapestry. In 1378 and 1456 it appeared again. Constantinople was besieged by the Turks in 1456, and the comet was regarded by the Mohammedans as a favorable sign because of the crescent-shaped tail. Christendom was so alarmed at the simultaneous apparition of the Turk and the comet that a Papal Bull was promulgated against both. In a measure, therefore, the history of Halley's comet is the history of civilization.

The problem of predicting the return of such a body as Halley's comet is one of considerable difficulty. If the sun and comet alone existed in space, the path of the comet could be determined easily. There are also

planets to be considered, and these have a marked perturbing effect.

So variable are the features of the comet, that in all the recorded instances of its return the descriptions never quite tally. In 1066 it created universal dread throughout Europe. In 1145, according to the Chinese, it had a tail 10 degrees long. In 1222 it is spoken of as a fine star of the first magnitude with a large tail. In 1456 it occupied a space nearly 70 degrees in length, and spread terror throughout Europe during the month in which it was visible. On the other hand, in 1531 and 1607 it does not appear to have been so conspicuous, for its tail was only 7 degrees long. In 1682 the comet attracted little attention except among astronomers, the tail being 12 to 16 degrees long. This apparent waning of the comet led to the fear that in 1758, the year of its first predicted return, it might be so faint as not to be visible at all. In truth, the tail was not visible until after perihelion, and was then inconspicuous because at its brightest it was seen against bright twilight. In 1835 the comet was visible to the naked eye during the whole of October, and its tail varied from 20 to 30 degrees in length. So marked have been the fluctuations, that there is some question whether the comet will be as magnificent in 1910 as it was in 1546, or whether it will be as insignificant as it was in 1607.

Halley's comet never reappears with clock-like regularity. The change in period from one revolution to the next in some cases has amounted to more than two years. The longest revolution so far recorded was that from 1222 to 1301—79 years and 2 months. The shortest round is the one now being accomplished in a little less than 75 years and 5.5 months. This extreme range of over four years in the orbital period renders necessary the most careful and laborious calculation of the effect of the attraction of all the planets upon the comet. It is indeed marvelous that mathematicians have come so near to predicting the exact date of perihelion at previous appearances. The best calculation hitherto made was that of Pontécoulant, who was only two days out of the way, an achievement which is not likely to be outdone by mathematicians of our time. In 1864 Pontécoulant published the results of his calculation of the present return, and placed it early in May, 1910, a result with which the observations of Cowell and Crommelin agree. Their reservation that possibly the comet may be at perihelion a few weeks sooner is amply justified by Wolf's early discovery. At present the comet is about 250,000,000 miles away from the earth. At the beginning of November its distance should be not more than 165,000,000 miles.

It is certain that if May 10, 1910, is the date of perihelion the comet will be disappointingly near the sun, so that the solar glare will rob it of its principal glories.

## THE SELDEN PATENT CASE.

The decision which has been handed down in the United States Circuit Court upholding the Selden patent will be received with mingled surprise and disappointment. We are probably safe in stating that few patent lawyers ever believed in the validity of the patent. If the defendants carry out their intention of appealing, it is not impossible that the decision will be reversed.

The Selden patent was granted on November 5th, 1895, to George B. Selden. Originally filed on May 8th, 1879, its final allowance was postponed until the birth of the automobile industry by delaying the filing of amendments. The chief claim in issue was "the combination with a road locomotive, provided with suitable running gear, including a propelling wheel and steering mechanism, of a liquid hydrocarbon gas engine of the compression type, comprising one or more cylinders, with suitable fuel receptacle, a power shaft connected with and arranged to run faster than the propelling wheel, an intermediate clutch or disconnecting device, and a suitable carriage body adapted to the conveyance of persons or goods, substantially as described." In other words, George Selden claimed all of the essential features of a modern automobile. Every one of the features embodied in this claim was individually old. If they were patentable in combination as a road carriage, was a new result produced? We doubt it. The internal-combustion motor was known before Selden's day. So were power shafts connected with and arranged to run faster than the shafts or wheels which they propelled. So were intermediate clutches or disconnecting devices between shafts running at different speeds.

Thus far, the patent has consumed nine years of litigation, almost half a million dollars, and 60,000 folios of testimony to provide material upon which to base a disappointing decision. The Selden patent expires on November 5th, 1912. It may be doubted whether its validity will be finally settled before it expires, if an appeal is taken.

That the patent was ever respected by the automobile industry is due largely to the fact that it was cheaper to pay the slight royalty demanded by its owners than to contest its validity.



## ENGINEERING.

It seems that unless the new cyanamide industry should create a big demand there is a possibility of an overproduction of calcium carbide. It is estimated that the yearly demand is 192,000 tons. According to Mr. Pitaval, the French output last year was 26,000 tons as against a maximum capacity of 50,000 tons. He estimated that the carbide factories of the world have an aggregate of 367,000 horse-power.

According to official Canadian railway statistics for the year 1907, the United States has a population of 381 for each mile of railway, and Canada 289. France has 1,590 for each mile of railway, and the United Kingdom 1,821. In India there are 10,119 people for each mile of railroad. In the United States there are 13.61 square miles of territory for each mile of railway; in Canada 161.8 square miles; in the United Kingdom 5.29 square miles, and in France 8.46 square miles for each mile of railway.

The proposed Forth and Clyde Canal has been criticised in the House of Commons on the ground that its cost of \$20,000,000 will be out of all proportion to its subsequent value. Admiral Campbell in reply lays emphasis upon its great strategic value as affording a quick means of transit of warships from the North Sea to the Atlantic, and *vice versa*. In view of the recent construction of a powerful naval base on the Firth of Forth the importance of such a canal outside of its commercial value has been greatly increased.

In view of his classic experiments of twenty years ago and his construction of a gigantic aeroplane, the announcement that Sir Hiram Maxim has built a new biplane cannot fail to arouse much interest in the world of aeronautics. The most valuable feature of his work was the determination of the best form of propeller by means of a whirling arm. Outside of the fact that his new motor (which, together with the rest of the machine, has been built by Messrs. Vickers, Sons & Maxim) is extremely light in proportion to its power, no particulars regarding the machine have been made public.

The proposed method of driving ships by the combination of steam turbine and motors, which at first was received rather coldly, is now beginning to receive the attention to which we consider it to be well entitled. In a recent discussion of the subject in *Cassier's Magazine*, the advantages of the system for cargo boats are stated as follows: More cargo can be carried; coal consumption is less; there is greater propeller efficiency in rough weather and less propeller racing; and the vessel is not totally disabled if the rudder or a propeller shaft is disabled. The disadvantages are that the first cost of the ship is greater and that a more skillful staff is required.

At the recent meeting of the British Association for the Advancement of Science at Winnipeg, interesting papers were read by Sir John Thornycroft on "Hydroplanes or Skimmers"; by Mr. C. B. Smith on "The City Hydro-Electric Plant" of Winnipeg; by Lieut.-Col. W. P. Anderson, Chief Engineer of the Department of Marine, on "Improvements in the Navigation of the St. Lawrence"; and by Col. G. W. Goethals, chief engineer and chairman of the Isthmian Canal Commission, on "Engineering and Construction Features of the Panama Canal." The latter was considered the most important paper, and will appear in full in the Association's Proceedings, only one paper in each section so appearing.

Two of the largest lighters afloat have recently been launched by Messrs. Rennie of Greenwich, England. They are entirely constructed of steel, 112 feet long, 30 feet beam, and 11 feet 9 inches deep, with a draft when lifting 500 tons of 10 feet. They are divided for 66 feet of their length by a well, on either side of which are six separate water-tight compartments, any or all of which can be quickly flooded for balancing, while they may be expeditiously cleared by a powerful steam pump. The quarters for captain and crew are forward, and boiler and engine room aft. The lighters have been built to the order of the Mersey Dock and Harbor Board, and are intended primarily for raising sunken vessels and similar objects.

The Metropolitan District Railway of London and its associated underground lines are subjected to a destructive wear of the rails which was not present in the days of steam operation. One form of this wear is known as "battering," which results in hollows that develop at distances of from two to three feet apart. It is generally found on the inner rail on curves. Corrugation is a well-known phenomenon on electric roads and constitutes one of the most puzzling features of rail wear under electric traction. This trouble is no doubt largely due to the fact that part of the weight of the motors is carried directly on the axles without the intervention of springs and that the center of gravity of the motor car is much lower than that of the steam locomotive. A partial remedy has been found in the use of high silicon rails, which show an increased life of about 30 per cent over rails of the standard composition.

## ELECTRICITY.

An electrolytic process for the production of bleaching solution is used by the Amazon Knitting Mills of Muskegon, Mich., by which the cost of bleaching is said to be less and the results obtained much more uniform.

Japan is falling in with the general movement for the electrification of railways, and the Hachioji-Kafu line of the Japanese middle district railway is to be electrified. Fifteen motor cars have already been ordered from the Osaka Railway Carriage Company.

The Canadian Department of the Interior has recently been estimating the available water power of Dominion streams, and concludes that there is over twenty-six million horse-power in accessible localities, of which only half a million has been hitherto developed. The largest power is on the Hamilton River in Labrador where 9,000,000 horse-power is available, the Canadian part of Niagara Falls coming second.

The Electrical World has an interesting discussion of Prof. Marks's article on the price of electric service. It is pointed out that on account of the difficulty of cheaply storing electrical energy the consumption of any individual user is as important a factor in the cost of serving him as the operating cost, and that it is therefore reasonable for some sort of standing charge based on his estimated or measured demand to be made in addition to a service charge based on operating cost.

Machinery aggregating 10,000 horse-power and other equipment to the total value of \$400,000 is now on its way to Dawson City, where Klondike mining operations are expected to be facilitated by the provision of electric power. An English company has taken over the present power station, the only coal mine in the district and the local telephone system. Water power is available for part of the year, but is complicated by floods at one season and drought at another. The present power plant uses wood fuel largely, the local supply of which is becoming exhausted, and considerable economies are expected from use of coal screenings hitherto wasted at the new company's power house, which will be erected at their mine.

The city of Glasgow, Scotland, whose record for an efficient and economical municipal tramway system is well known, has also a remarkably well-conducted electric light and power supply department, according to figures recently received for the past year's working. In spite of a decrease in income of \$38,000, due to reduced charges for current, increasing use of economical metallic filament lamp, and general trade depression, an actual increase in available profit balance of \$14,000 has been made. The aggregate horse-power sold is 29,500, an increase of 6,000 over the previous year, and 1,232 new consumers have been added. Eighteen million units out of thirty-three sold were for power purposes bringing in on the average 1½ cents per unit.

The experiments, which we described about a year ago, with apparatus for the destruction of harmful moths by means of a combination of electric light and a suction blower, have been repeated with great success at Zittau, in Germany. The beam from a search-light mounted on the roof of the municipal electric plant is played upon the forest several miles distant and the moths come fluttering up the beam in swarms to where the intake of a powerful suction blower is concealed below massed arc lamps. The moths are drawn in by the suction and exhausted into a wire net cage which is removed as often as filled. As much as 140 pounds weight, representing some 400,000 moths, has been destroyed in this way in one night.

It is not generally known that the disturbances in Persia, reports of which from London have occupied much space in the press of late, pass over the longest telegraph circuit in the world. The telegraph operator at Teheran "speaks" directly to his colleague in London, 4,000 miles away, by wire, automatic repeaters taking the place of operators at ten points on the route. The first repeating station from London is at Lowestoft, where the message is carried forward 200 miles by cable under the North Sea to Emden, Hanover, where it is again automatically repeated; stations at Berlin, Warsaw, Rouno, Odessa, Kertch, Sukhum, Kaleh, Tiflis, and Tauris flash it instantaneously without human intervention, the operator at Teheran being the first to handle it since it left London. The line is continued to India, but in no other place is there so long an automatic circuit.

Mr. George H. Cove of Somerville, Mass., has a solar thermo-battery which is claimed to produce enough current in ten hours' sunlight to supply thirty tungsten lamps for three days. The apparatus consists of a frame of violet glass, like a large window, below which a number of metallic plugs are set in an insulating material. One end of each plug is constantly exposed to the sun while the other is shaded and cool, and the rays permitted to pass by the violet glass set up a reaction in the special alloy used, causing a constant flow of current to the storage batteries.

## SCIENCE.

The famous lion of Lucerne appears to be doomed. The entire face of the sandstone rock in which the figure is carved is falling to pieces, and, in spite of every effort on the part of the local authorities, the lion is crumbling away and becoming disfigured.

The Duke of the Abruzzi has made a new record in mountain climbing. The highest ascent hitherto made in the Himalayas, the scene of the Duke's exploit, was by the Norwegians Muradas and Robertsen, who reached a height of 7,300 meters (more than 23,725 feet). The Duke mounted Bright's Peak, which is 7,600 meters (above 24,700 feet) in height. This peak is in the Godwin-Austen group.

Scientists now have placed at their disposal the highest meteorological and astronomical observatory on the American continent. It is situated on the top of Mount Whitney, California, 14,000 feet above sea level. Realizing the value for effective and progressive astronomical and meteorological work of an observatory far above the clouds and free from dust and smoke near great cities, the Smithsonian Institution decided to build a suitable laboratory on Mount Whitney. Now that the observatory is opened it will be used by scientists of the Smithsonian Institution and by others to make observations. The Smithsonian will permit the building to be used by any scientist gratuitously.

We have already made the statement in these columns that the Lick Observatory under W. W. Campbell sent an expedition to the top of Mount Whitney for the purpose of spectroscopically comparing the atmospheres of the moon and Mars, the object being to settle once and for all the mooted question of Martian water. Inasmuch as the moon has an atmosphere which if not non-existent is at least inappreciable, the comparison of its spectrum with that of Mars's atmosphere should prove conclusively whether or not there is any water on Mars. A telegram has been received at Harvard College Observatory from Prof. Campbell in which he states that together with Dr. Albrecht he compared the spectra of Mars and the moon and detected only a little water vapor on Mars. The bands which were measured were of equal intensity and very faint. A reply from Prof. Lowell will naturally be looked for with some interest. It will be remembered that Mr. Slipher of Prof. Lowell's staff has stated that he discovered spectroscopic evidence of water on Mars.

The common impression that the soils of the United States are wearing out and that the crop yields are on the decrease is declared to be erroneous by Prof. Milton Whitney, chief of the Bureau of Soils. The results of his investigation will be published in the next bulletin of the Department of Agriculture. In summing up, Prof. Whitney says that a careful study of the data appears to justify two conclusions—first, that the productivity of the newer agricultural soils of the United States is not decreasing. Individual farming deteriorates and soils wear out, but, as a whole, it seems probable that we are now producing more crops per acre than formerly. The cultivation of the land has been more intelligent, the principle of rotation of crops has been better observed, and, in latter years, a more careful use of fertilizers has been made. In addition, we must recognize the increase in farm animals and stock, the improvements in such by selection and breeding and the increased population which is forcing attention to more intensive methods of cultivation.

An effective method of freeing the air of rooms from dust and germs is especially desirable for primary schools, children's hospitals, surgical operating rooms and spinning mills. The method hitherto in use consists in supplying a current of air which has previously been purified, more or less completely. Richet has devised a simple method of purifying the air confined in a room by causing it to circulate continuously through an apparatus which retains the dust and microbes. The apparatus is simply an electric fan which revolves in a vertical cylinder and produces a current of nearly 2 cubic feet per second. Water, or some other liquid, drips from a 3-quart vessel, at the rate of 1 quart per hour, upon the blades of the fan, from which it is projected, by centrifugal force, in fine drops to the wall of the cylinder. The impurities of the upward blast of air are caught by the spray, which then trickles down the cylinder to a large basin in which the whole apparatus is set. Richet employed glycerin and soap solution, but the air can be purified very well by a spray of water alone. One hundred thousand microbes, estimated by the usual methods, were thus collected in three hours from the air of the laboratory. The dried organic matter collected in the same interval weighed about 1 grain, and the mineral matter ¼ grain. The same apparatus can evidently be employed for the chemical purification of the air by substituting appropriate solutions—cuprous chloride for the removal of carbon monoxide, potash or soda for carbon dioxide, etc.

## HUDSON AND HIS EXPLORATION OF THE HUDSON RIVER.

The name of Hudson has been given to the Hudson River, not by any means because he was its original discoverer, but because he was the first navigator to explore the river throughout its navigable length, and leave behind a detailed account of his voyage. It will therefore be fitting to preface the present record of Hudson's voyage by a brief reference to the discoveries of earlier explorers.

After the return to Spain of the remnant of Magellan's expedition in 1522, it began to be well understood in Europe that a vast ocean must separate the New World and Asia; and the early navigators forthwith began to search for some route by which they could avoid the long journey from Europe to Asia by way of the southern seas, and find a direct route in more northerly latitudes. The explorers sought eagerly for a northwest passage, gradually laying their courses farther and farther up among the ice floes of the Arctic regions. The eastern coast of North America was carefully searched, and the tiny caravels of those days were sailed into the mouths of great rivers, in the hope that they would prove to be straits or channels opening through into the Western Ocean. Among these early explorers was Lucas Vazquez d'Allyon, who tried for a passage by the James River and through Chesapeake Bay in 1524. In 1525 Estevan Gomez sailed down the coast from Labrador to Florida, making a record of Cape Cod, Narragansett Bay, and successively of the mouths of the Connecticut, the Hudson, and the Delaware rivers. Early in 1524 Giovanni da Verazano, who was born in 1480 at Florence, crossed the Atlantic with a single ship and a crew of fifty men. He sighted Cape Fear, N. C., and coasted north to latitude 50 deg. About the last of April, 1524, the "Dauphine," as Verazano's craft was called, arrived off a low point of land, now known as Sandy Hook, where, seeing an inviting harbor, Verazano sailed into the roadstead. The ship's boat was manned and rowed through the Narrows into the Upper Bay, where a hasty survey was made of its islands and inlets, and the mouth of the noble river which flowed into it. He speaks of the river as "a very great river" (*una grandissima riviera*); and the name Grande River was used by some of the leading map-makers of Europe during the sixteenth century. When the Dutch took possession of this part of the country, the name "Groote" was substituted for the Italian term. Henry Hudson was no doubt induced to explore the "Grande River" by a letter from Capt. John Smith, who wrote that it was a strait connecting with the western sea, which in those days was believed to lie not very far from the Atlantic seaboard.

Of Henry Hudson the man we know comparatively little, and that little is comprised within the years 1607 and 1611. He was born in or near London; but of the exact date of his birth there is no certainty. His first appearance is on April 19th, 1607, when, with eleven companions, he is found partaking of Holy Communion in a little church in London, prior to embarking on his first recorded voyage. Our last sight of him is when he passes from view among the mists of Hudson Bay on June 22nd, 1611, turned adrift with a few companions by the mutinous crew of the "Half Moon." No authentic portrait of the man exists. He came of a seafaring family, had a wife and children, and evidently belonged to a prominent family. He made four recorded voyages, the first, second, and fourth under English auspices, and the third under the Dutch. In 1586 Parliament incorporated "The Fellowship of English Merchants for the Discovery of New Trades," which was better known as the Moscovy Company; and it was in their employ that Hudson, on his first voyage, made an effort to reach China by passing between Greenland and Spitzbergen. At latitude 81 deg. 30 min. he was checked by the Arctic ice and returned home. This voyage lasted from April 23rd to September 15th, 1607. The second voyage, in 1608, lasting from April 22nd to August 26th, had the same object in view. This time he endeavored to pass between Spitzbergen and Nova Zembla. After reaching latitude 75 deg. 30 min. he was driven back by the ice. In 1609 he entered the service of the Dutch East India Company, and made the voyage

which resulted in the exploration of the Hudson River. His last voyage, made under the auspices of the Moscovy Company, commenced on April 17th, 1610, had for its object a search for a northwestern route to the Pacific Ocean through what is now called Hudson's Strait; and it was here in the following June that Henry Hudson, John Hudson, and seven others, mostly sick and disabled, were set adrift by the mutinous crew in an open boat, with a gun, some powder and shot, an iron pot, some meal, and a chest of carpenter's tools. The ultimate fate of the great explorer,

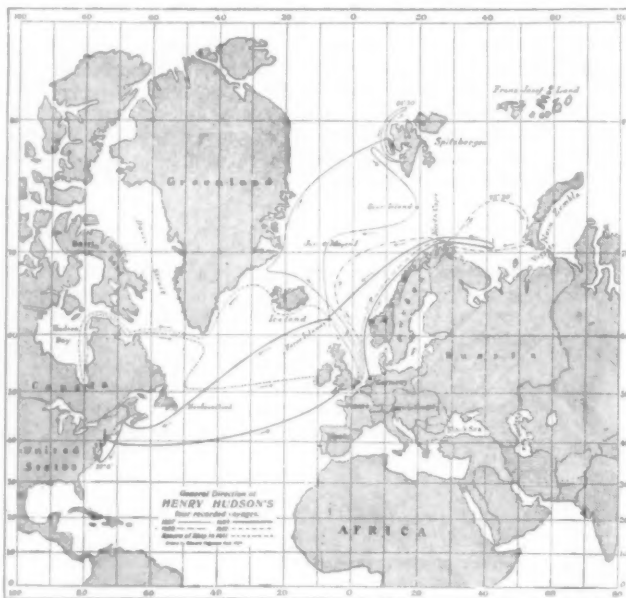
Pacific, in the latitude of 60 deg. On May 5th he rounded North Cape, but, baffled by the ice and by the discouragement of his crew, he determined, instead of returning home, to sail direct to the coast of America at the latitude of 40 deg., where he hoped to find a northwest passage by a strait which his friend, Capt. John Smith, in the letter sent to him from Virginia, informed him led into the Western Ocean somewhere between New England and Virginia. On July 18th he cast anchor in a harbor on the coast of Maine. He touched at Cape Cod; sailed to a point one hundred miles

south of Chesapeake Bay; and then turned northward again and entered Delaware Bay. Finding the river unnavigable, he ran back to the ocean and sailed up the coast, and on September 2nd was off the New Jersey shore, and anchored probably off what are known as the Navesink Highlands to the south of New York Bay. On the following day the "Half Moon" let go her anchor inside of Sandy Hook. The week was spent in exploring the bay with a shallop, or small boat, and "they found a good entrance between two headlands" (the Narrows) "and thus entered on the 12th of September into as fine a river as can be found."

The log of this voyage was kept by Robert Juet, who was probably the mate of the "Half Moon." It is written in the quaint English of that period, and is entitled "The Third Voyage of Master Henry Hudson, toward Nova Zembla, and at his return, passing from Farre Islands to New-Found Land, and along to Fortie-Foure Degrees and Ten Minutes, and thence to Cape Cod, and so to Thirty-Three Degrees, and along the coast northward to Fortie-Two Degrees and one Halfe, and up the river neere to Fortie-Three Degrees."

In his passage up the river, Hudson made progress according as wind and tide were favorable, the time from sundown to sunrise being always spent at anchor. On Monday, the 14th, he passed through a "very high and mountainous" country, probably the Highlands. On the following day, mention is evidently made of the Catskills, when the log records that they "came to other mountains which lie from the river side." On Saturday, the 19th, the little ship had reached the northerly limits of its trip, and anchored off what is probably now the northern section of the city of Albany. Further exploration of the river was made in the shallop, in the expectation of finding deeper water beyond the shoals. This was a vain hope, however, and the conviction must finally have come to the heart of the intrepid adventurer that once again he was foiled in his repeated quest for the northwest passage. On Wednesday, the 23rd, the "Half Moon" started on her return trip down the river. On the 29th she was at the northern entrance to the Highlands, having reached "the edge of the mountains or the northernmost of the mountains." Detained by a heavy gale until October 1st, Hudson weighed anchor on that day and reached Stony Point. Finally, on Friday, the 2nd, the "Half Moon" cast anchor off "acliffe that looked of the colour of a white greene," which is considered to have been undoubtedly "the green serpentine outcrop" at Castle Point, Hoboken.

Evidently the "Great River" made the same pleasing impression upon Hudson as it has done on the many millions who have voyaged between its banks in the intervening three centuries. Says he: "It is as pleasant a land as one need tread upon. The land is the finest for cultivation that I ever in my life set foot upon." With a few exceptions, he found the native Indians to be friendly disposed. Dressed in skins and with the characteristic decoration of feathers, wearing copper ornaments on their necks and carrying bows and arrows, they smoked large red or yellow copper tobacco pipes. To the little ship they brought tobacco, dried currants, grapes, corn, pumpkins, and beaver and other skins, which they bartered for knives, hatchets, and trinkets. The country appears to have been quite populous with the Indians, who lived in dome-shaped huts, built of saplings and covered with bark. They existed chiefly on corn, which, together with beans, was dried for their winter use. Fish and birds also formed part of their diet, and mention is made of salmon, mullets, rays, and sturgeon. At the various places where Hudson landed he was usually received amicably and with no little ceremony. It is evident that Hudson's treatment of the Indians was kindly, and the voyagers made a good impression upon the natives, which was destined



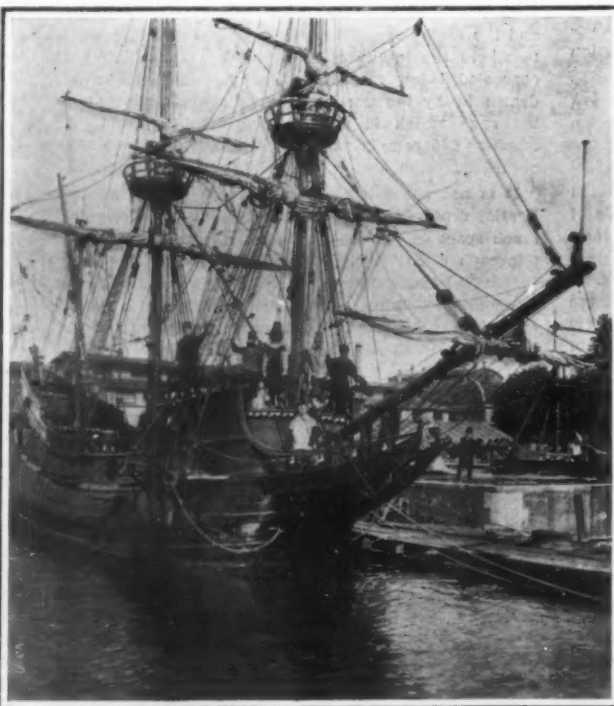
The voyage of 1609, during which he discovered the Hudson River, is shown by a full black line.

MAP SHOWING HENRY HUDSON'S FOUR RECORDED VOYAGES, 1607-1610.

whether he died of starvation or drowning, or was frozen to death, is a matter of pure conjecture.

On the 8th of January, 1609, a contract was made between "the Directors of the Dutch India Company of the Chamber of Amsterdam" and "Mr. Henry Hudson, Englishman, assisted by Jodocus Hondius," who was to act as interpreter. In the Dutch copy of the contract preserved at The Hague, Hudson's Christian name is three times spelled "Henry," and he signed the document in the same way; so that in the opinion of the Hudson-Fulton Celebration Commission, "as he was an Englishman, it is a mistake to call him 'Hendrik.'"

The "Half Moon" set sail from Amsterdam April 4th, 1609, with a crew of eighteen Dutch and English sailors. The object of the voyage, as per the contract, was to seek a passage to the north of Nova Zembla, and by an easterly course to reach what is now the



The raised superstructure forward contains the quarters for the crew. Below the bowsprit, furled on its yard, is the curious square sail known as the "blind sail." The sailors are dressed in the costume of 1609.

THE REPLIC OF THE "HALF MOON": PHOTOGRAPH TAKEN JUST BEFORE SHE WAS SHIPPED TO AMERICA.



to have a beneficial and lasting effect on the subsequent history of this State.

It was while at Albany that Henry Hudson decided "to try some of the chiefe men of the country whether they had any treacherie in them"; and accordingly he "tooke them down into the cabin and gave them so much wine and aqua vitae that they were all merrie, and one of them had a wife which sate so modestly, as any one of our country women would do in a strange place. In the end one of them was drunke."

Not always was the intercourse of this convivial character. After the return of the "Half Moon" to the lower harbor, and when John Coleman and four others were exploring in the shallop, they were attacked by the natives, and Coleman was killed. This was on September 6th. Other conflicts occurred on the 9th and the 15th of September, and on October 1st, the log records how an Indian who had climbed up the rudder to the cabin window was caught stealing and shot. The following day the Indians attacked in force, and were driven off with a loss of eight or ten killed. On the 4th of October the "Half Moon" sailed down the harbor and out to sea, and "on the seventh day of November," according to the log, "being Saturday by the grace of God, the 'Half Moon' safely arrived in the range of Dartmouth in Devonshire in the year 1609."

#### THE "HALF MOON."

When the replica of Henry Hudson's "Half Moon" was lifted by the floating crane at the Brooklyn navy yard from the deck of the "Soestdyk," on which she was brought over from Holland, and lowered into the water, there was a general expression of surprise at her diminutive appearance; for she was actually no larger than a small harbor tug. On rowing over to the craft and going aboard, however, it was at once evident that what she lacked in size, she more than made up in general staunchness and strength of construction. Bluff of bow and high in the poop, as was the fashion in naval architecture of three hundred years ago; built of heavy oak timbers, and planked and decked with the same material, the "Half Moon" was well calculated to stand the buffeting of long deep-sea voyages. Moreover, her underwater model is such, with its long clean run, that, although it must have been slow work beating to windward, it is certain that with the wind free and sheets started the little craft must have been good for say six knots, and possibly—under favorable circumstances—a little more than that. All the same, in view of the diminutive size and exceedingly cramped quarters of the "Half Moon," one is filled with admiration for the daring and resourcefulness of the men who struck boldly to the northwestward in such a cockle shell of a boat, on voyages of many months' duration and in a quest for a northwest passage, which must needs lead them on to dangerous coasts and amid treacherous shoals, of which there was no chart, beacon, or buoy, to give them friendly guidance.

The "Half Moon" must be seen to be appreciated. Of 80 tons displacement, she is only 80 feet in length over all, 63 feet on the waterline, 16 feet 11 inches beam, 10 feet 1 inch molded depth, and 7½ feet draft of water. She was built by a committee of patriotic Dutch citizens, who provided the necessary funds, her plans being drawn from original sketches and documents prepared by the late instructor of shipbuilding in the Dutch navy. In the parade up the Hudson River she will be manned by officers and a crew from the Dutch ship of war "Utrecht," all dressed in the quaint costumes of three hundred years ago. Forward is the raised forecastle, the sleeping place of the crew, provided with five berths. Forward of this and below the bowsprit is the galley, an extraordinarily exposed and wet position, where, says tradition, the sailors were placed for punishment. At the after end of the boat on the main deck was the position for the steersman, whose head projected through the steeply-sloping quarter deck above him and was protected by a curious canopy. In front of the steersman were a compass, a sand glass, and a log glass. Upon the main deck and covered in by the steeply-sloping deck, known as the quarter deck, is the captain's cabin. Under his berth, in an artistically bound chest, are the books which comprised the captain's small library. Upon the diminutive table is a sea chart, a faithful reproduction of the one existing copy, mentioned by Shakespeare, which is in the British Museum. On the table also is a copy of the contract with Hudson for his notable voyage, dated Janu-

ary 8th, 1609. Here also are the primitive dividers and measuring scales for plotting the course. The cabin contains a Jacob's staff, the primitive sextant with which Hudson determined, with a fair amount of accuracy, his latitude. All of these articles are faithfully copied from prototypes in the Netherland Museum. Above the captain's cabin is a smaller one for the accommodation of the mate; and above this is the lofty poop deck.

From a naval constructor's point of view, one of the most curious things about the "Half Moon" is the ex-



Note the steel cradle in which the boat was carried on the deck of the "Soestdyk." The transfer was made by the floating crane.

#### "HALF MOON" BEING LIFTED FROM STEAMSHIP TO DOCK AT THE BROOKLYN NAVY YARD

aggerated, upward slope of the after part of the main deck and of the quarter and poop decks above it, the effect of which was to give great elevation to the poop. Curious indeed to our eyes is this lofty structure; but it must have been an excellent position from which to navigate the ship. About four feet below the main deck is the "tween deck" or the "derdeck," where the head room is so limited that the crew must have at times performed some of their duties on all fours. Here are the two old-fashioned cannon, the primitive kitchen and berth for the cook, a bread room and berth for the steward, and a gunner's room in which the powder was stored. Below is the hold, in which were stored the provisions, drinking water, cable, and cargo. The "Half Moon" carries three masts and a bowsprit. Below the latter is a curious square sail known as the "blind sail." On the foremast are a foresail and a topsail, on the mainmast a mainsail and a main topsail, and on the mizzen is a lateen sail. The shrouds, stays, spars, and in fact the whole of the rigging, standing and running, is exceedingly strong,



View looking aft, showing the lofty poop, containing the steersman's position and the cabins for Hudson and his mate.

#### DECK VIEW OF THE "HALF MOON."

and well set up. The old Dutch East India Company, whose chief office was in Amsterdam, placed on all its vessels the initial letter of the port from which they sailed. This accounts for the large letter A on the stern of the "Half Moon." Other signs painted on the vessel are a starry heaven, a comet, planets, and a half moon. Below these are the name of the vessel and the arms of Amsterdam and of the company.

#### THE FOUR PERIODS OF HUDSON RIVER HISTORY.

For the lovers of history, none of the pageants of the Hudson-Fulton Celebration will equal in interest the great parade of Tuesday, September 28th, which will tell the story of the past three hundred years of Hudson River history, in a procession of over half a hundred floats, representing the successive periods of Indian, Dutch, English, and American occupation.

Henry Hudson, during his exploration, found the river occupied by two great branches of the aboriginal Indians, the Algonquins at the mouth and in the lower river, and the powerful league of the Iroquois, or Five Nations, at its head. With a few slight exceptions, Hudson's reception was friendly, and both he and his crew appear to have treated the Indians with consideration. It is certain that such conflicts as occurred were insignificant in comparison with the battle fought between the Canadian Indians under Champlain on the shores of Lake Champlain and a party of Iroquois Indians—a conflict which occurred only a few days before Hudson sailed into New York Harbor. "The contrast between the French and the Dutch and English treatment," says the Hudson-Fulton Commission, "led to the formation of the famous Covenant Chain of friendship between the Indians and the latter, and prevented the French from ever obtaining a permanent foothold in the State of New York."

The Dutch, who succeeded the Indians as owners of what is now New York State, were in 1609 the leading commercial nation of the world, and Amsterdam, from which Hudson set sail, was its leading port. The interest aroused among the early Dutch traders by Hudson's voyage led to the erection, as early as 1613, of traders' huts along the Hudson River. The first permanent settlements were made at Fort Orange (Albany) in 1614, and at New Amsterdam (New York) two years later. The colonial history of New Netherland began with the landing on Manhattan Island of Peter Minuit, as the first Governor-General, in 1624. Under New Netherland was included the territory between the Connecticut and Delaware rivers. The English took possession in 1664; surrendered to the Dutch in 1673; but once more gained possession, this time destined to be permanent, in 1674.

Henceforth New Netherland was to be known as New York, New Amsterdam as New York city, and New Orange as Albany; but the Dutch origin of New York is still commemorated in such names as Brooklyn, Harlem, and Staten Island. Regarding this momentous change, the Commission is of the opinion that the merger of the Dutch and English régimes was accomplished more completely and naturally than a change of jurisdiction could have been made between almost any other two nations in the world; for the Dutch were more closely allied to the old Anglo-Saxon stock from which the English are descended than any other living European people. Intense rivals in commerce, England and Holland had worked hand in hand for years for the liberties of Europe, and there were radical bonds of sympathy between them, which contributed materially to the progress of the colony of New York.

The American or United States period began, of course, with the Declaration of Independence on July 4th, 1776. The geographical position of the Hudson River, which forms part of the great highway of travel from the Atlantic seaboard to the Great Lakes and Canadian territory, rendered it strategically of the very highest importance, and, therefore, the main object of contention between the opposing forces. The British realized that if they could establish complete possession of the Hudson Valley they would cut the colonies in two; and by establishing a route of communication between Canada and New York, they would be able to defeat the colonies in detail. The vast range of incidents connected with the Hudson River Valley has rendered it necessary for the Commission to confine the floats to the representation of events more immediately connected with New York city.

## FULTON AND HIS LIFE WORK.

The forthcoming festivities commemorate the first complete exploration of the Hudson River by Henry Hudson and the inauguration by Robert Fulton of successful commercial steamboat navigation on its waters. Hudson was not the first navigator to see the Hudson River, and neither Robert Fulton himself nor the Commission which has organized and carried through the celebration has ever claimed that Fulton was the original inventor of the steamboat. It is rarely that a complete invention leaps full fledged from the brain of any one man. Almost invariably it is the product of the disconnected labors of separate individuals, each of whom contributes his quota to the ultimate result. Three men above all others—Symington on the Forth and Clyde Canal, Fitch on the Delaware, and Fulton on the Hudson River—will be forever associated with the invention of the steamboat; and it is because Robert Fulton combined with his fine engineering sense a large executive and commercial instinct, and was backed by the financial and political influence of Chancellor Livingston, that he was able, not only to put a practical steamship afloat on the Hudson River, but to establish the infant enterprise as a permanent commercial success.

Fulton was born in Little Britain, Lancaster County, Pennsylvania, in 1765. As a boy he showed a decided gift for drawing and mechanics, to which was joined an unusual facility for mathematical calculations. At seventeen years of age he went to Philadelphia to take up the study of portrait and landscape painting and mechanical drawing. In this he must have shown considerable ability; for at the age of twenty-one he had saved sufficient means to purchase a home for his widowed mother, in Washington County. In the following year he went to England to study art under his distinguished compatriot, Sir Benjamin West, who subsequently, in 1792, was elected president of the Royal Academy. That Fulton was an artist of no small attainment is shown by the character of the work which has survived him, and by the fact that his portraits were exhibited at the Royal Academy and at the Society of Arts in Great Britain. His own portrait, painted by his brush, which now hangs in the rooms of the American Society of Mechanical Engineers in New York, is an excellent piece of work, and shows distinctly the influence of the master under whom he studied.

An artist by profession, Fulton was an engineer and inventor at heart. Benjamin West's influence, coupled with his own charm of personality and undoubted social gifts, brought him into touch with many leading men in England, notably the Earl of Stanhope, whose interest in mechanical and physical science is well known. On September 30th, 1793, Fulton wrote to the Earl, offering to make known to him his scheme for moving ships by steam and his plan for an inclined plane for the operation of canals. In the same year, also, he invented a mill for sawing marble and other stone, and actually had one in operation near Torbay, Devonshire. His interest in steam navigation at this time is shown by a letter to Boulton & Watt, dated November 4th, 1794, asking what would be the cost of a steam engine, "which is designed to be placed in a boat." The letter was written from Manchester, where he met young Robert Owen, subsequently known as the distinguished social reformer. Fulton interested Owen in his plans for the more rapid and cheaper excavation of canals, and they became co-partners in his inventions. Meanwhile he was writing a "Treatise on Canal Navigation," which appeared in 1796. In 1797 he went to Paris, where he obtained two French patents for panoramas. A lasting evidence of his work in this direction is to be found in the Rue des Panoramas and the Passage des Panoramas in the French capital. Here he lived with the American Minister, Joel Barlow, of whom he painted an excellent portrait now owned by his descendant, Robert Fulton Ludlow of Claverack, N. Y. It was during his residence in Paris that he began to turn his genius for invention almost exclusively to the field with which his name was to be so honorably associated. His first efforts were directed to the invention of means for prosecuting submarine warfare. He invented a system of torpedoes operated by clockwork, and devised methods of attack which were wonderfully similar to those that were used with such disastrous effect

in the late Russo-Japanese war. He proposed to float down upon the enemy two such torpedoes tied together by a line, which, being intercepted by an enemy's ship, would swing around, strike her sides, and explode. His most effective work in this field was the construction of a practical submarine or "plunging"



From a painting by Benjamin West in possession of Fulton's grandson, Robert Fulton Ludlow, of Claverack, N. Y.

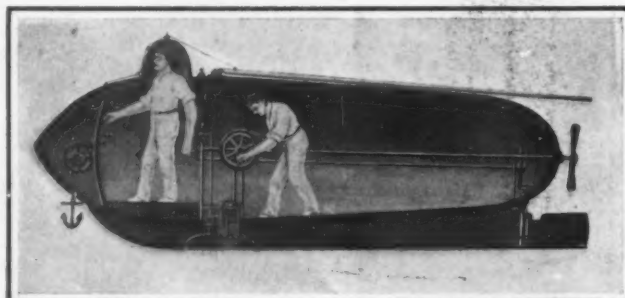
ROBERT FULTON; 1765-1815.

boat, called the "Nautilus." This vessel, 6 feet in diameter and 20 feet long, was built of iron and copper, and in general outline resembled the modern submarine. It was provided with a sail for surface navi-



THE BRONZE MEDALLION OF ROBERT FULTON ON HIS MONUMENT IN TRINITY CHURCHYARD.

gation, which could be folded back upon the boat when diving. To submerge the boat, water was admitted, which was removed by pumping when it was desired to come to the surface. It was driven by means of a



Built of copper and iron; driven by a hand crank and propeller; was submerged by admitting water; air was replenished from a tank of compressed air; remained under water 5 hours with three men aboard. Fulton is the undisputed inventor of the first successful submarine. He antedated the present submarine boat by 100 years and demonstrated by successful tests before officials, first of the French and later of the English navy, the practical character of his vessel.

FULTON'S SUBMARINE THE "NAUTILUS."

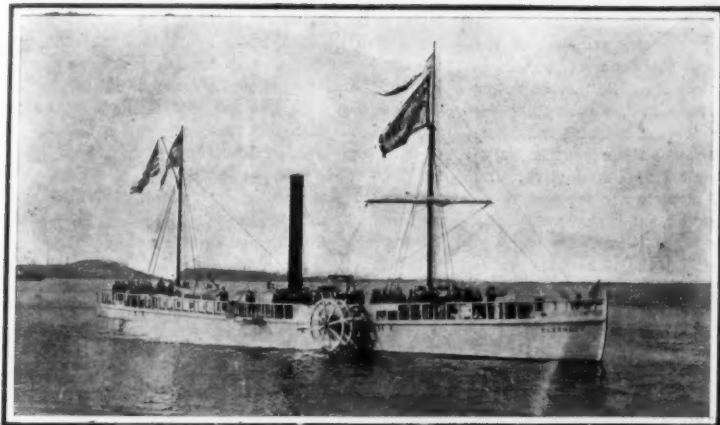
propeller through a man-operated crank wheel, from which power was transmitted through bevel wheels to a propeller shaft running through the center of the boat. The steering, operation of the pump, and the raising and lowering of the sail, were all accomplished from the interior by the methods shown in the accompanying engraving. Fulton made an exhibition on the Seine, descending with one man, remaining twenty minutes below the water, and coming successfully to the surface. At Brest, in June, 1801, he descended with three men to a depth of twenty-five feet, and remained below for one hour, the air being renewed from a reservoir of air under high pressure. On another occasion he attacked a specified boat in the harbor, attached one of his torpedoes, and blew the boat to pieces. This occurred in August, 1801. The significance of these exploits is enhanced when we bear in mind that the experiments above referred to were made to demonstrate to Napoleon I. the value of Fulton's invention for attack upon the English fleet. His plan was to build steamboats which were to act as tugs to tow the vessels containing Napoleon's army of invasion across the English Channel; and while the steamboats were to afford Napoleon an opportunity to strike a blow upon land with his army, Fulton's system of submarines would enable the French navy to strike an equally telling blow by sea. As the French government failed to accept Fulton's submarine and torpedo inventions, he subsequently returned to England and laid his plans before the British government. Mr. Pitt, the Prime Minister, was favorably impressed, and Fulton was given an opportunity to attack a brig which was anchored off Deal in the English Channel. He launched a torpedo, and by completely destroying the vessel demonstrated to naval and military officers and to a large concourse of spectators the success of his invention. The British government, however, for obvious reasons, did not wish to encourage the development of submarine warfare, for they realized its great potentiality. They offered Fulton a considerable reward if he would suppress his plans forever.

This he refused to do, saying to the committee that waited upon him: "I will never consent to let these inventions lie dormant, should my country at any time need them."

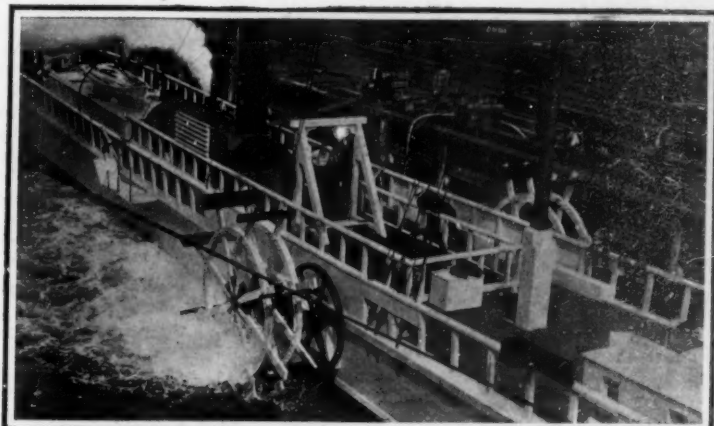
Fulton, again a resident in France, realizing that he had failed to interest either government in his system of submarine warfare, turned to his favorite scheme, and bent his energies to the development of a practical steamboat. He made application to the French government, filing a description and plans of his boat, which have been preserved in the archives of the Conservatoire des Arts et Métiers, Paris. The wide study of what had been done and was then being attempted in the development of the steamboat, with which Fulton prepared himself, is shown in these plans, and the reader is directed to the illustration of the boat, in the chapter on "Steamboats Prior to the Clermont," which appears on page 221. The drawing is especially valuable for the light which it throws upon the "Clermont," of which the original drawings have disappeared. The date of the letter to the French Commission was January 25th, 1803. Fulton built a small boat, in which he placed his boiler and engine; but on the eve of his demonstration before the Commission, during a heavy wind, the craft, unable to carry its burden, broke in two, and the wreck sank to the bottom of the river. The engine, which was presumably the one ordered from Watt, seems to have come through the disaster unharmed; for Fulton immediately built another boat, 66 feet long by 8 feet beam, and in August, 1803, made a fairly successful trial in the presence of members of the Institute and a crowd of onlookers. In spite of

this disappointment, Fulton was doomed to disappointment; for the French government failed to take up his invention. But his star was now in the ascendant. The wheel of fortune took a turn in his direction, when Robert R. Livingston was sent to France to act for the United States in the matter of the Louisiana Purchase. This able man, who had himself already given much study to, and made several experiments in, the development of the steamboat, was quick to see the excellence of the Fulton plans, and became from that time on his ardent associate and never-failing backer. "Fulton had genius, and Livingston had the genius to perceive it"; and out of the combination of interests thus formed, there was to emerge four years later that curious but capable little craft, the "Clermont"—practically identical in design, and the lineal descendant of, the boat which steamed successfully on the

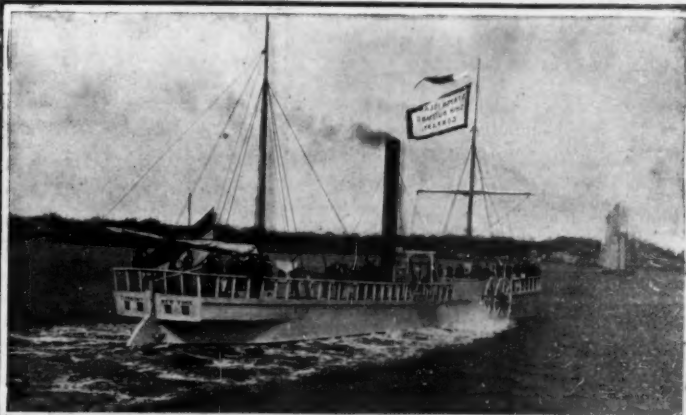
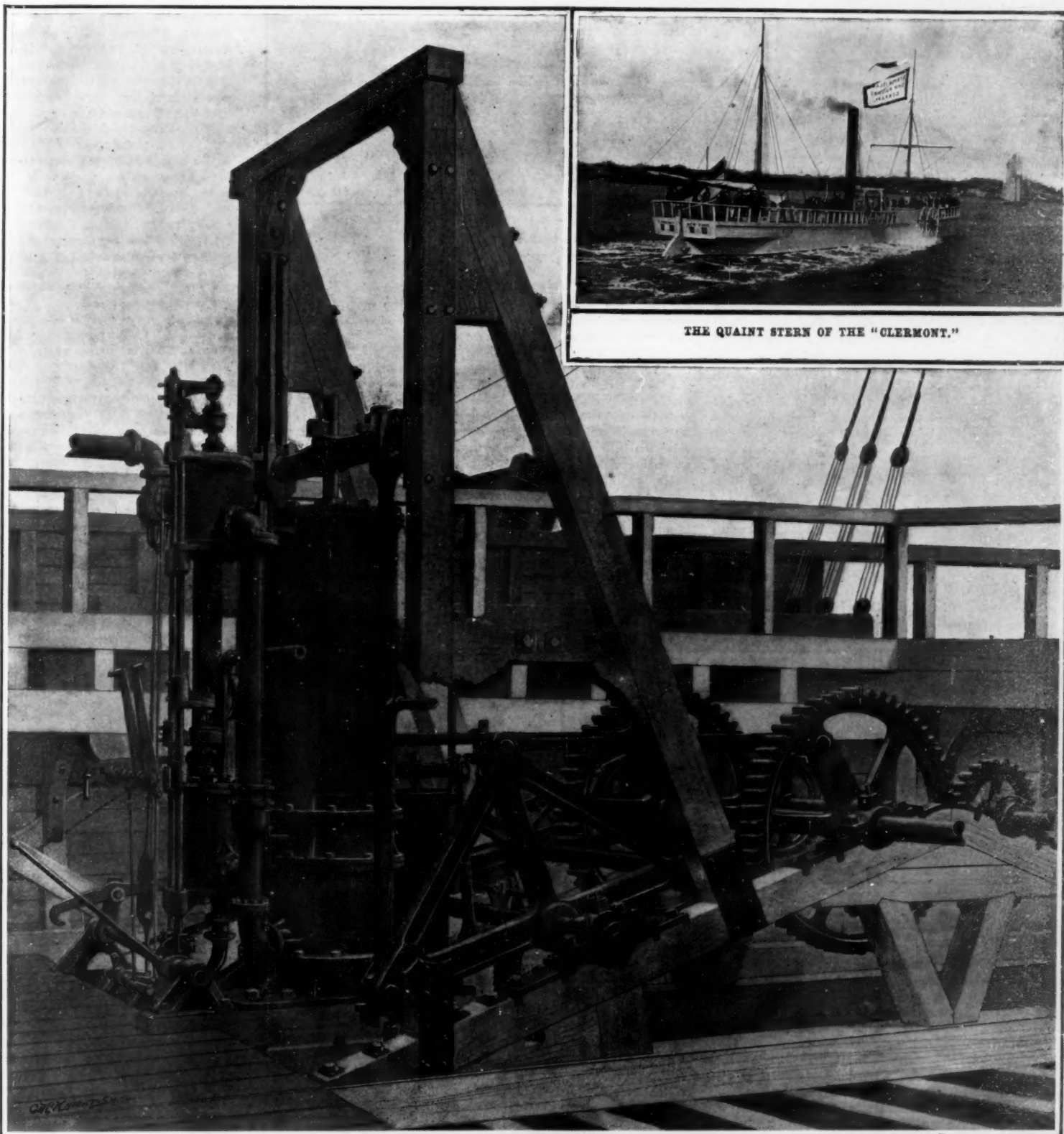




THE "CLERMONT'S" TRIAL TRIP: SEPTEMBER 14TH, 1808.



DECK VIEW, SHOWING FLYWHEELS OUTSIDE HULL.



THE QUAIN STERN OF THE "CLERMONT."

With the exception of the eccentric, valve gear, and starting and stopping mechanism, which were modernised in accordance with government requirements to ensure safe handling during the water parades, this replica is an exact copy of the original of 1807.

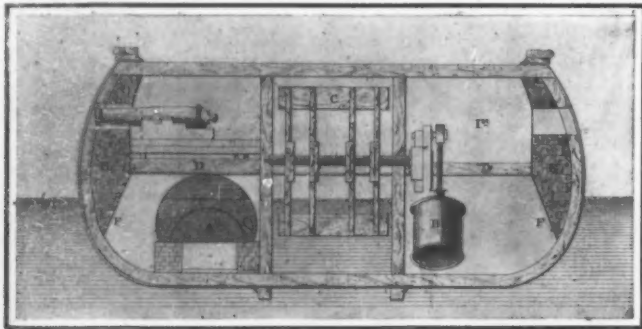
The main parts of the engine were built by Watt in England in accordance with Fulton's order of August 6, 1803, which called for "a cylinder of 24-horse-power double effect, the piston making a 4-foot stroke, the valves and movements for opening and shutting them, the air-pump piston and rod, the condenser with its communications to the cylinder, and air pump." The A frame and guides: the cross-head: the bell-crank lever with its connecting rods to cross-head and crank wheels: the crank wheels, paddle wheels and shaft, and the flywheels and shaft with gear for driving the same, were all Fulton's own design; and the arrangement was well adapted for keeping the weight low in his very narrow boat with its small margin of stability. In the original engine the valves were probably operated by a vertical reciprocating rod, carrying pins which engaged the valve-tripping devices.

(Drawn on board the replica of the "Clermont" by the artist of the SCIENTIFIC AMERICAN.)

THE ENGINE OF THE "CLERMONT"

river Seine. Preliminary to our description of the "Clermont," it is well to make it clear that Robert Fulton is entirely free from any charge of plagiarism. It has been asserted that, because Fulton inspected the work both of Symington on the Clyde and Fitch on the Delaware, and was familiar with Fitch's plans as left in charge of Aaron Vail, U. S. consul at L'Orient, France, it was from these sources that he derived the design of the "Clermont." Now, while it is true that Fulton was in touch with these men and their work, and probably saw their steamboats in operation, there is nothing in the design of the "Clermont" to indicate that her hull and the general arrangement of her engine were not the design of Fulton himself. On the contrary, there is abundant written evidence that the form of the boat and the connections from the cylinder to the paddle wheels were Fulton's. This is said with due appreciation of the fact that Fulton went to Boulton & Watt at Birmingham, England, for the essential parts of his engine. They were the foremost engine builders of their day; and it was a wise step on Fulton's part to order the cylinder, condenser, and air pump from a first-class firm. Both Fitch and Symington, it is true, designed and built their own engines throughout; but this fact does not invalidate Fulton's claim to be considered as the naval architect of the "Clermont"—a boat which was quite unlike any other that had been built, and that was so well designed as to prove a thorough commercial success.

While Fulton was yet in Paris and a few days before the trial of his boat on the Seine, he again wrote to Boulton & Watt, asking them to build him an engine, which he no doubt intended for the boat that he had in mind to build on his forthcoming return to America. On the date of August 6th, 1803, his letter says: "Will you be so good as to make me a cylinder of a 24-horse-power double effect, piston making a 4-foot stroke? Also the piston and piston rod, the Valves and movements for opening and shutting them, the air pump piston and rod, the condenser with its communications to the cylinder and air pump. The bottom of the cylinder cast in form as in the drawing and the dispositions of the parts as near as possible as they stand in the drawing. The other parts can be made at New York. . . . The situation for which this engine is designed and the machinery to be combined with it, will not admit of placing the Condenser under the cylinder as usual." The drawing which accompanied this letter showed the condenser placed forward of the cylinder, and not underneath it, as was the practice in the Boulton & Watt engines. Mr. H. H. Supplee, who has probably given a more thorough study to this phase of the subject than any other investigator, is of the opinion that Fulton wished to place his cylinder directly upon the floor of the boat, in order to keep its weight as low as possible.



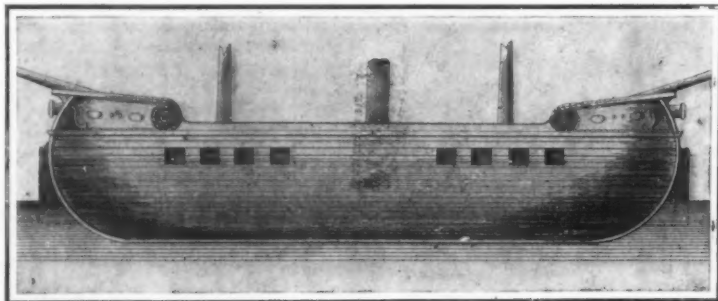
This view shows the engine B, driving paddle wheel C in a central waterway; the boiler A; and the massive wooden side protection E, 5 feet in thickness.

#### MIDSHIP SECTION OF THE "DEMOLOGOS."

We are inclined to agree with him; for the original beam of the "Clermont," which was only 13 feet, rendered her laterally very unstable. Furthermore, the boat on the Seine, which doubtless formed the basis of the design of the "Clermont," shows the condenser separate from the cylinder. There can be no doubt, after reading the Boulton & Watt letter, that Fulton had the outlines of the "Clermont" engine clearly in his mind, and its general similarity to the engine of the boat on the Seine is strong evidence that the "Clermont's" engines were, at least as to their general plan and connections, original with Fulton. On the other hand, the drawings which accompanied Fulton's patent of 1809 show the condenser placed beneath the cylinder, a construction which has been followed in the replica of the engine.

In drawing the plans, it was found that, since the replica of the "Clermont" would have a considerable number of people aboard during the festivities, parades, etc., it would be necessary to depart somewhat

from the original plans, in order to comply with the requirements of the government inspectors and secure a reliable boat, suitable for the purposes of the Commission. Hence, in the interests of historical accuracy, it is advisable to note that the motive power departs in some respects from Fulton's original design, although in the main it is a faithful reproduction. This is particularly true of the eccentric, valve gear, cut-off, and starting and stopping devices; and it takes only a glance at our drawing to see that these parts belong to a later period, and are practically similar to those now in use on walking-beam engines. In the drawings of the boat on the Seine, the valve gear and the air pump are shown to have been operated by levers and quadrants. Probably Fulton used the "tappets and tappet rod," which were current practice for working the valves in Boulton & Watt engines. Another change is in the boiler, which in the original "Clermont" was built of copper, and carried a pressure of probably not more than three to five



Designed by Fulton for the United States Navy; launched in 1814 and completed shortly after his death. Length, 156 feet; beam, 56 feet; depth, 20 feet; paddle wheel, 16 feet diameter; engine cylinder, 4 feet diameter, 4 feet stroke; speed, 4 1/2 knots.

#### THE "DEMOLOGOS"; THE FIRST STEAM WARSHIP.

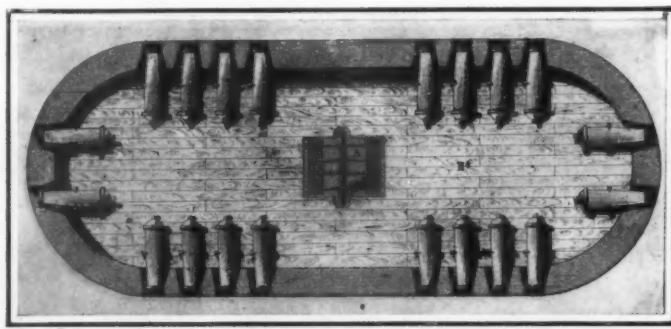
pounds above the atmosphere. In the "Clermont" of 1907, the boiler, in order to meet the government requirements, is built of steel, and carries twenty pounds pressure. With these exceptions in mind, the visitor to the "Clermont" may be satisfied, both as regards the hull and the engines, that she looks very much as she did on her first memorable trip up the Hudson. Fulton's design, if we consider the crude condition of the art in those days, is creditable, and it is a noteworthy fact that if we raise the bell-crank lever above the cylinder, we have an engine which is remarkably like the walking-beam engine of the present day. Fulton, however, wished to keep his weights low in the boat; and the plan adopted is admirable for this purpose. Two connecting rods from the crosshead are coupled to a bell-crank A-shaped pair of levers, from the top of each of which a connecting rod transmits the motion to a pair of crank spur wheels upon the inboard ends of the paddle-wheel shafts. In order to carry the engines over the dead centers, Fulton provided a pair of flywheels, which were carried upon separate counter-

V-shaped at and below the waterline, but above the water was carried out with a square overhang. This form was decided upon by Fulton as the result of towing experiments with models which he carried out himself; and he seems to have been of the decided opinion that this was the best form to secure the desired speed. She was provided with a limited amount of sail, of which, at least on her first trip, she seems to have made but little, if any, use. The paddle wheels, 15 feet in diameter, were uncovered, and consequently, if any breeze were blowing, the passengers were pretty well drenched with water.

Let it not for a moment be imagined that the public of that day had the least appreciation either of the genius of Fulton or the momentous character of the work he was doing. When, on Monday, August 17th, the little craft cast loose from her moorings near the old State's Prison, which stood on the square now bounded by Washington, West 10th, West, and Charles Streets, many of the thousands that lined the shore of the river had come to deride "Fulton's Folly"; and he made his preparations for the start to the accompaniment of jeers and catcalls. At 1 o'clock the hawser was drawn in, the throttle was opened, and then, amid the curious hush which immediately fell upon the multitude, the side wheels began to turn, and with Fulton at the helm the "Clermont" moved slowly out into midstream and headed north for Albany. Skepticism gave way to approbation and delight, and amid thunders of applause the "Clermont" moved slowly up the river, and was finally lost to sight in the upper reaches of the river. At 1 o'clock on Tuesday the little vessel tied up at Clermont Dock, the landing for Chancellor Livingston's place, having covered the 110 miles from

New York against the wind at an average speed of 4.6 miles an hour. Resuming the journey at 9 o'clock on Wednesday morning, the "Clermont" reached Albany, 40 miles distant, at 5 P. M., the running time for the whole distance having been 32 hours, which gave an average speed of a little over 4 1/2 miles per hour.

We have shown in another chapter how phenomenal was the development of steam navigation on the Hudson River as inaugurated by this eventful trip, a development in which Fulton took a leading part. In 1812 he put his first ferryboat in commission, although to Stevens must be given the credit for having started a ferry to Hoboken in the previous year. The boat, which was double-hulled, made her landings at a hinged, floating bridge, to which she was guided by lines of piling. Fulton was thus the originator of our present system of ferryboats. In 1810 we find him before President Madison explaining his models and plans for torpedo warfare. In March, 1814, Congress authorized the construction of a steam war vessel to be built from Fulton's plans. This, the first steam warship in the world, was constructed with a double



The armament consisted of twenty 32-pounder guns. The plans provided also for two 100-pound submarine guns for attacking the enemy below the water-line.

#### GUN DECK OF THE "DEMOLOGOS."

shafts, rotated by means of pinions secured at their inboard ends. The air pump and feed pump are operated through connections from the bell-crank levers, as shown.

About the correctness of the design of the replica of the hull of the "Clermont," there can be no doubt whatever. The plans, drawn by Frank E. Kirby and J. W. Millard, are based upon a letter of Fulton's, which reads: "My first steamboat on the Hudson River was 150 feet long, 13 feet wide, drawing 2 feet of water, bow and stern 60 degrees"; and upon the second enrollment of the "Clermont," on file in the New York Custom House, which describes the vessel as having "one deck, and two masts," and gives her dimensions as 149 feet length, 17 feet 11 inches breadth, and 7 feet depth. The enlargement in beam is due to later changes which were found necessary to increase the vessel's stability. The "Clermont," as originally designed, had therefore a long narrow hull, with parallel sides; a V-shaped bow; and a stern which was

hull. Its dimensions were: Length 156 feet, breadth 56 feet, depth 20 feet. The paddle wheel, 16 feet in diameter, was driven by an engine, whose cylinder was 48 inches in diameter by 5 feet stroke. As will be seen from our drawing, the sides of the "Demologos," as she was called, were strengthened by massing heavy timbers, until a thickness of five feet was reached. She mounted twenty 32-pounder guns on the gun deck. Fulton, who was present at the launching of the vessel on October 29th, 1814, did not live to see her completed; indeed, it was his devotion to the work of her construction, which led him to spend many hours on her deck in the winter time, when he was troubled with a heavy cold, that brought about his death, which occurred February 23rd, 1815, at his home in what is now Battery Place. He was buried in the Livingston vault on the south side of Trinity Church, and to the northwest of the monument and tablet erected to his memory by the American Society of Mechanical Engineers in 1901.



## Correspondence.

## THE NUMBER OF OUR ANCESTORS.

To the Editor of the SCIENTIFIC AMERICAN:

The search for truth is said to be often of more benefit than its attainment; and I am glad to see that a solution of the problem is beginning to emerge out of darkness, thanks to Mr. Eckles's letter in your issue of August 21st, although it only lifts a corner of the curtain.

He proves what I have thought all along, that people are far more closely related than is generally supposed, but there is another side to the problem he does not touch.

Consider the five or six distinct races of mankind, and the different nations of the world; such isolated people as the Japanese, Chinese, South Sea Islanders, Eskimo, Thibetans, and many detached tribes of India, Africa, and the other continents and islands. Must there not be thousands, not to say millions, of people living to-day who have not the least commingling of blood in their veins for thousands of years at least?

Suppose we say that there are only twenty different people, a very conservative estimate, and take one from each as totally unrelated to the others for say one thousand years past, and reduce the number of their estimated progenitors (1,094 millions) to 10 per cent to meet Mr. Eckles's blood-relationship (a very generous allowance, as the isolation of groups works both ways, and tends to keep distant communities apart), and we arrive at 2,000 millions living at that date against the 1,500 millions of to-day.

Los Angeles, Cal.

A. K. VENNING.

## WHAT IS HEAT LIGHTNING?

To the Editor of the SCIENTIFIC AMERICAN:

I note in your issue of August 28th a communication from Mr. A. Graham of Topeka, Kan., regarding the classification of lightning. I had the opportunity several years ago of proving that the so-called "sheet" or "heat" lightning is nothing more or less than a reflection, as he states, of the regular "chain" lightning.

I had a discussion with the man in the telegraph office in a small town on a railroad running directly east and west, regarding what he called "heat" lightning. I maintained that it was lightning flashes so far away or so high in the clouds, that we could neither see the flash itself nor hear the thunder.

During the whole summer we watched the storms very closely; practically all of them came from the west; so we were able, by calling up the operators in the different stations, to tell just what was actually occurring, and in every single instance we could find other operators near us reporting "sheet" lightning, while those at twenty-five, thirty, forty, and even fifty miles off were reporting regular lightning, accompanied with thunder.

It is the writer's opinion, based upon the observation of that summer, that there is but one kind of lightning, viz., that which we see reaching from cloud to cloud or from cloud to earth when the storm is near by. The same kind, in fact, that we can ourselves produce on a miniature scale between points of a spark plug in an automobile engine cylinder. The appearance of so-called "heat" lightning is very easily produced on a cloudy or foggy night, by the jumping of a trolley wheel from its wire, thus making an arc that throws its reflection on the clouds.

Pontiac, Mich.

A. R. WELCH.

## HOW FINGER AND THUMB MARKS WERE DISCOVERED THROUGH A PHOTOGRAPHIC PROOF.

To the Editor of the SCIENTIFIC AMERICAN:

A few weeks ago a photographic proof upon a piece of gelatine printing-out paper was given to the writer to tone with other photographic prints, in the usual chloride of gold and borax toning baths. No particular attention was paid to this print. It was treated the same as the others, namely, washed well, toned, fixed, and washed well again for half an hour.

The prints were all squeegeed upon thoroughly-cleaned ferrotype plates. When the prints were dry they were lifted in the usual way, by inserting the tip of a jack-knife blade at one corner, and pulled off. Every print came off perfectly clean, leaving no impression upon the ferrotype plate, except the proof that had been toned. Upon examining the part where this proof had been dried, it was discovered that quite a number of mixed finger marks were clearly discernible upon the ferrotype plate, although not visible in the print. The explanation appears to be this: Gelatine being a colloid body, the greasy matter, lactic acid, and sodium chloride contained in the perspiration of the skin became impressed and retained upon the gelatine surface, although not sufficiently to become visible to the human eye. Traces of lactate and chloride of silver being formed, became partly washed out previous to toning, and completely dissolved upon fixing, but the greasy matter remained. This too would become more perfectly retained when the gela-

tine came in contact with water; the result being that the greasy matter, not being affected by any of the chemicals used in toning and fixing, became manifest when the print dried down upon the ferrotype plate, leaving this greasy matter upon the japan, thus giving an admirable clue in the line of detection.

New York, N. Y.

A. J. JARMAN.

## ELECTRICAL FIREBALLS: WHAT ARE THEY?

To the Editor of the SCIENTIFIC AMERICAN:

This question, that I sent to the English Mechanic and which was published in that journal on July 30th, page 618, letter 576, brought out a number of very interesting answers in subsequent numbers of the same paper, notably in those of August 13th and August 20th; and if your correspondent, Mr. A. A. Graham, who writes the article on "Lightning" in the SCIENTIFIC AMERICAN for August 28th, will take the trouble to read the letters mentioned, in the English Mechanic, he may have occasion to modify his opinion regarding "electrical fireballs."

Mr. Graham says: "The recorded instances of fireballs are so rare and questionable, with no evidence of their electrical nature, that the information is not sufficient to enable one to form even a belief in their occurrence."

While entertaining very much the same belief as Mr. Graham, I received a letter from a very intelligent lady, who is spending the summer in a bungalow situated in the pine woods bordering on Buzzard's Bay, Massachusetts.

She writes as follows: "I was awakened about 2 o'clock by hearing rain, and rose to close the windows. The darkness was appalling. There was a flash of lightning and a loud peal of thunder, and as I got to the window I saw a luminous ball descending, some distance away, and when I looked again some minutes after, there were numerous luminous bodies along the roof of a house about fifty feet away; but these lights were stationary, and I watched them till the first streaks of day."

Of course, we know very well what the immovable lights were. The St. Elmo fire, an electrical appearance, is quite commonly seen on the masts and spars of vessels, and on projecting points of high buildings; but the fireball is a very different affair, and there seems to be abundant evidence of its occurrence, that is, if such scientific men as Arago, Humboldt, Flammarion, and E. B. Dunn of the U. S. Weather Bureau may be considered good authority; and in addition to these, letter 59 in the English Mechanic of August 20th, from Edwin Holmes, a member of the Royal Astronomical Society, who describes a fireball that he witnessed himself, may serve to satisfy Mr. Graham that such things as fireballs are not entirely deceptive appearances; and I would be very glad myself to hear from readers of the SCIENTIFIC AMERICAN what they know about them.

J. D. HYATT.

New Rochelle, N. Y.

## DOES MUNICIPAL OWNERSHIP PAY?

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of August 21st, second column on page 123, you speak of the effect that the electrifying of the London tramways has had on the passenger receipts of the Great Eastern Railway of England. You make the following statement:

"The Council Tramways are a municipal undertaking, and while giving good service, have been run hitherto at a loss, the deficit being paid out of the rates."

As a matter of fact, the report presented a few months ago by the London County Council on the results of the year 1907-8, showed that the gross receipts were £1,663,000 (\$8,315,000), which was a surplus on working of £493,000 (\$2,465,000) and a net surplus after payment of interest on capital outlay and providing for the repayment of debt of £45,406 (\$227,030). The latter amount was carried to the renewals fund.

There has been such a persistent attempt to depreciate municipal ownership throughout the United States, that it is hard to find justice given the subject. This attempt to mold public opinion through the press has been largely brought about by a "press bureau," maintained for that special purpose. While I am personally of the opinion that municipal ownership in the United States would result in failure (because of the deplorable amount of graft and corruption in the administration of municipal affairs) yet it does seem as though municipal ownership *per se* should be given fair show.

ARTHUR J. CRAMP.

Chicago, Ill.

## EDITORIAL ADDENDUM TO LETTER.

We appreciate the tone as well as the substance of this correction, and regret that we had not noticed the later report quoted. The note was based on a general impression, which was however correct as to the deficits in administration of the L. C. C. tramways in former years. While we are desirous of treating the question of municipal ownership as impartially as

possible, however, we would point out that even in the report mentioned, the net surplus was carried over to renewals fund, with the probability that it would be more than used up in the ensuing year. The only justification of municipal trading, in our opinion, is that it should be carried on at a profit, the profit going to the relief of the rates. Since the above-mentioned surplus was not so used, it can hardly be considered as a profit; besides which, it does not represent interest upon the capital expenditure of the Council at a rate upon which any private corporation could survive.

## SUPERSENSITIVENESS OF THE BLIND.

To the Editor of the SCIENTIFIC AMERICAN:

In a recent issue of the SCIENTIFIC AMERICAN, I noticed an article on the supersensitiveness of the blind, in which cases were cited of remarkable acuteness of the remaining four senses. The article in question calls to mind a notable experience I had in New York city in 1896.

It will be recalled by thousands of people that the late Charles Broadway Rouss, the blind merchant of that city, offered one million dollars to anyone who would restore his sight. The offer was sensational and was widely circulated in every civilized nation. Thousands of letters, written in many languages, poured into the big Broadway store suggesting remedies, and the blind merchant was besieged by many offering treatments for the restoration of his sight. Rouss, although blind, was a busy man, always at his desk directing the affairs of his great establishment. He was too busy to take treatments, he declared, and so he selected a substitute whose name was Martin and who was alike blind from atrophy of the optic nerve. He was too poor to pay for treatments and was glad to act as a substitute for the millionaire who agreed to defray his expenses. It was understood that Rouss would undergo any treatment that would benefit Martin.

I made arrangements with Rouss for the treatment of Martin and, accordingly, Martin came to my residence every day for about two months. The treatment was electrical from a primary battery of my own invention. The files of the New York World of July 31st, and Journal (since changed to American) of August 1st, 1896, will show that my treatment of the case became quite sensational. I believed that Martin had made some slight improvement and might regain his sight. I finally gave up the case, however, deciding with all oculists that atrophy of the optic nerve is incurable.

Martin was a native of New York city and had been blind nine years. He was of a fearless and impetuous disposition, and went about over the city without a guide. He passed up, down, and across the great thoroughfares frequently and only a few times collided with a bicycle, which vehicle he detested. I was with him on occasions when I marveled at the perfect freedom with which he walked along the crowded streets, showing not the slightest timidity and requiring no aid whatever from me.

Once I left my residence on 22nd Street near Eighth Avenue with Martin for a walk through the city to Third Avenue and thence down town. In passing he would name with great accuracy the streets and notable buildings. His eyes showed no indication of blindness and no one suspected that he was blind. I was amazed to see him cross Broadway at 14th Street with perfect ease, and imagine my astonishment when he shied around some timbers that had been set up across a sidewalk to prop the wall of a building undergoing repairs. He got off and on street cars without a blunder and made his way across crowded streets without betraying his blindness. He used no cane nor did he feel his way with his hands. Had I not known that he was actually blind I would have believed he was feigning.

I asked him how he knew his way and avoided collisions, and he invariably told me he did not know. He only knew that he cared nothing for his life, and often remarked that he would rather be dead than blind. He seemed to be guided by what I shall term a miraculous instinct superinduced by a subconscious mental condition. I am inclined to the belief, in the absence of a better theory, that he was directed by what Hudson terms "the subjective mind."

Arbuckle, Cal.

WALTER W. FELTS.

Owing to the careful adjustment and regulation of temperature necessary in bacteriological incubators, a new incubator has recently been built which will be heated by electricity, and which it is expected will thus overcome the difficulties with gas-heated incubators. Incandescent lamps are used in the new heater to maintain the required temperature. A new mercury regulator controls the lamps. The instrument was tested quite recently for a run of forty-five days, and the variations in temperature during this time were practically nothing. The incubator is formed with a triple wall, providing a water jacket and an air space, and is covered with asbestos finished in white enamel.

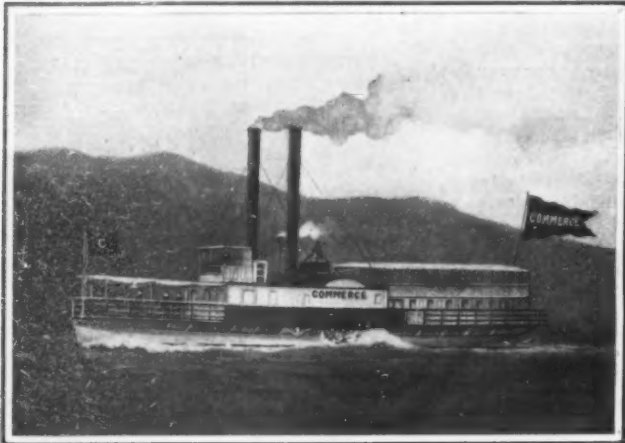
## DEVELOPMENT OF THE HUDSON RIVER STEAMBOAT.

In that broad field of human activity which is covered by the term "engineering," there is probably no product of American design and construction that bears more distinctive national characteristics than

the growing demand. The "Car of Neptune" was built in 1808, the "Paragon" in 1811, the "Firefly" in 1812, and the "Richmond" in 1813-1814. It was not to be expected that so profitable a venture would be allowed to pass unchallenged, and a company was formed at Albany which built two boats to run in opposition to the Fulton line. Fulton and Livingston, however, were granted a perpetual injunction against the opposition company, and the two vessels were turned over to Fulton and broken up. Rendered thus doubly secure

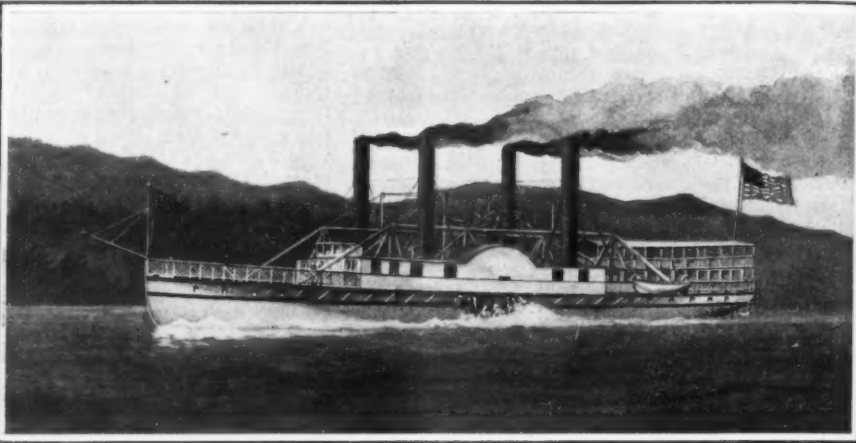
inger," from the Battery across the Bay to Elizabethtown, N. J. Robert R. Livingston, Fulton's backer and close associate, died in 1814, and Fulton on February 24th, 1815.

There can be no doubt that the monopoly granted to Fulton served to delay the development both of the steamboat and of river transportation in general. The decision of the Supreme Court in 1824 opened the river to steam navigation by boats propelled "by fire or steam," and forthwith the improvement of the



Length, 130 feet; beam, 24 feet; depth, 8½ feet. Engines: Cylinders, 16-inch and 30-inch diameter by 4-foot stroke. Altered in 1852, and renamed "Ontario." Broken up in 1894.

THE "COMMERCE," 1825.



Length, 180 feet; beam, 28 feet; depth, 9 feet. Driven by two engines. Cylinders, 42-inch diameter by 10-foot stroke. Carried two boilers on each guard. In August, 1832, ran from New York to Albany in 9 hours and 49 minutes.

THE "CHAMPLAIN," 1832.

the American river steamboat. Also, we venture the assertion that there is no type of passenger vessel plying upon river, lake, or ocean that presents such a perfect picture of graceful lines and contour, or carries such a suggestion of speed as the American river steamboat. That it should show such undisputed beauty is surprising, when we bear in mind that this type of boat has been developed during the past hundred years along lines of the strictest utility, and under the stress of the most severe competition; a competition whose intensity has not been exceeded even in the construction of the competing railroads, which have thrown their elaborate network over the face of the country. Every one of the peculiar characteristics of the river steamboats has been due, not to the mere caprice of the builder, but rather to certain exacting physical conditions of the work which had to be done. The shoal draft, the wide overhanging guards, and even that distinctively American survival (we had almost said anachronism), the walking-beam engine, are instances of "the survival of the fittest" after one hundred years of endeavor to find the best type of boat for this work.

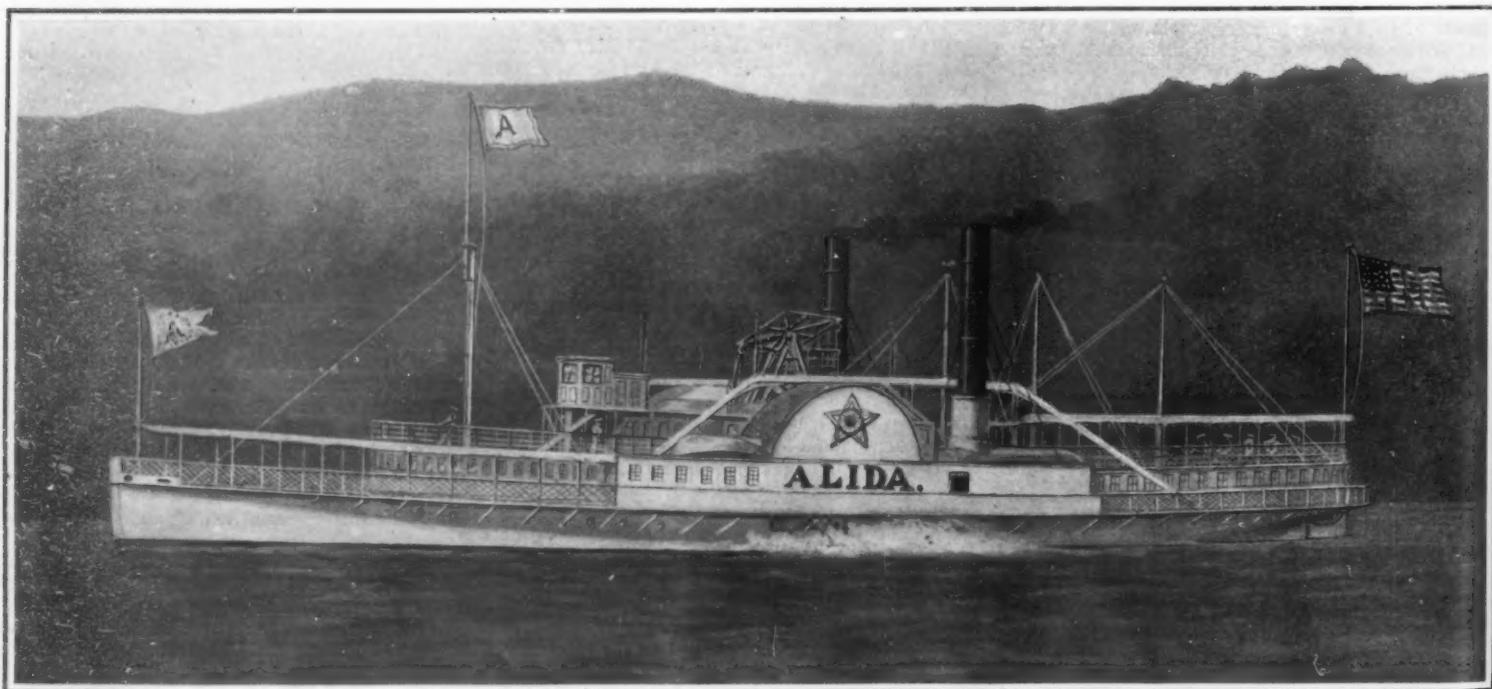
The successful trip of the "Clermont" to Albany in 1807, in the then incredibly brief time of 32 hours, brought the new system of transportation into immediate favor, and the growth of traffic, in spite of the fare of \$7 for the single trip, was such as to warrant the construction of four additional steamboats to meet

in the possession of their exclusive rights in the State of New York. Fulton and Livingston took out additional patents, and settled down to the development of the river carrying trade. Not much is known of the four successors to the "Clermont" mentioned above, beyond the fact that the weakness of construction, which was evident in the "Clermont," was remedied. The rectangular cross section was abandoned; a keel and keelsons were introduced to give the longitudinal stiffness; the flat bottom was abandoned in favor of a dead rise, and the bilge was given the rounded form which characterizes the later vessels.

In 1811 Aaron Ogden, Governor of New Jersey, petitioned the New York Legislature against the Fulton monopoly, but was unsuccessful. He built a steamboat called the "Sea Horse," to run between Elizabethtown, N. J., and New York city, and this vessel is credited by John H. Morrison in his "History of Steam Navigation" with being fitted with an engine that was the pioneer of the American beam engine. Subsequently, Livingston and Fulton gave Ogden permission to run his steamboat on his ferry route for a period of ten years. Out of this arrangement came the litigation, ultimately carried to the United States Supreme Court, by which the steamboat monopoly, which had existed for seventeen years, was broken. One of the most active opponents of the Fulton-Livingston interests was "Commodore" Vanderbilt, who in the early 20's was operating two boats, the "Bellona" and "Stoud-

steamboat began to go forward by leaps and bounds. The original North River Company was at once confronted by opposition lines. The Hudson River Line built three boats, the "Constitution," "Constellation," and "Independence," and certain people in Albany set afloat the "De Witt Clinton." The year 1824 is notable for the launching of the first steamboat to carry compound engines, the "Henry Eckford." The cylinders were 12 and 24 inches in diameter, and the stroke 4 feet. The new type of engine gave satisfaction, and it was used in several vessels, including the "Commerce," launched in 1825, of which we present an illustration, and the "Sun" of about the same date. The dimensions of the "Commerce" show the trend of development. She was of less length than the "Clermont," 130 feet as against 150 feet, but of nearly twice the beam, the "Clermont" having been altogether too narrow for stability. Her engines had cylinders 16 and 30 inches in diameter by 4 feet stroke. Altered in 1852 and renamed "Ontario," this remarkable vessel was not finally broken up until the year 1894. The "Sun," whose engines were of the same compound model and of the same dimensions, is credited with having made the trip from New York to Albany in the year 1826 in twelve hours and sixteen minutes, with thirteen landings, so that in the intervening nineteen years since the voyage of the "Clermont," the time of passage had been reduced about two-thirds.

The year 1826 is notable for the fact that John Ste-



Length, 265 feet; beam, 30 feet; depth, 10 feet. Engine, 56-inch diameter by 12-foot stroke. The boilers, as in all the boats of this period, were carried upon the guards, outside of the hull. On May 5, 1848, ran New York to Hudson, 116¼ miles, in 5 hours and 20 minutes at speed of 21.8 miles per hour.

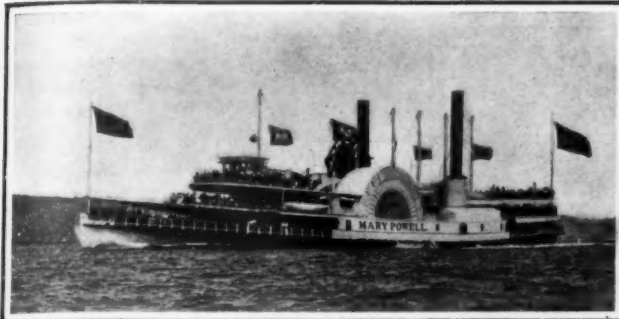
THE "ALIDA," 1947.



vens, the Fulton monopoly having been broken, entered the Hudson River passenger business, and applied his genius to the design of engines and steamboats; and it is doubtful if anyone who worked at the problem in the first half century succeeding Fulton has left a deeper impress. Possessed of a natural

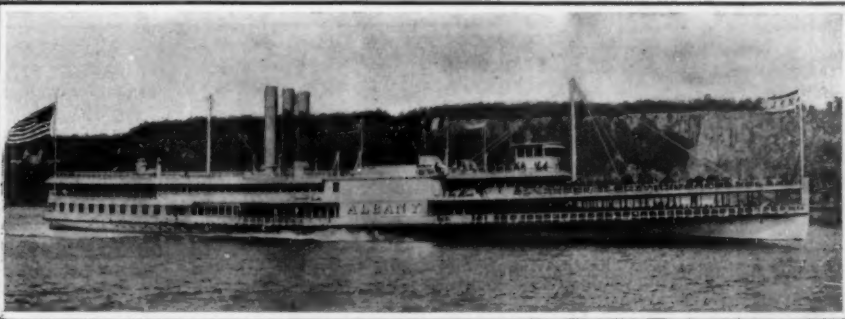
It was at about this time that the practice was followed in some of the steamboats of providing two separate engines, one for each paddle wheel. The "North America," above referred to, had engines of this kind, as did the "Champlain," 1832, which is shown in one of our illustrations. The "Champlain" also illustrates

wonderful development in the speed of the Hudson River steamboat. At that time there were no steam vessels anywhere in the world that could approach these famous craft in speed, and that American shipbuilders and engineers should have gained such a commanding lead over the Old World is to be attributed



As originally built in 1861: Length was 260 feet; beam, 34½ feet; depth, 10½ feet. Engine: Cylinder, 62-inch diameter by 12-foot stroke. Vessel rebuilt in 1875 and 1881. On August 7th, 1874, ran from New York to Poughkeepsie, 74½ miles, in 3 hours and 10 minutes at speed of 22.54 miles per hour.

THE "MARY POWELL," 1861.



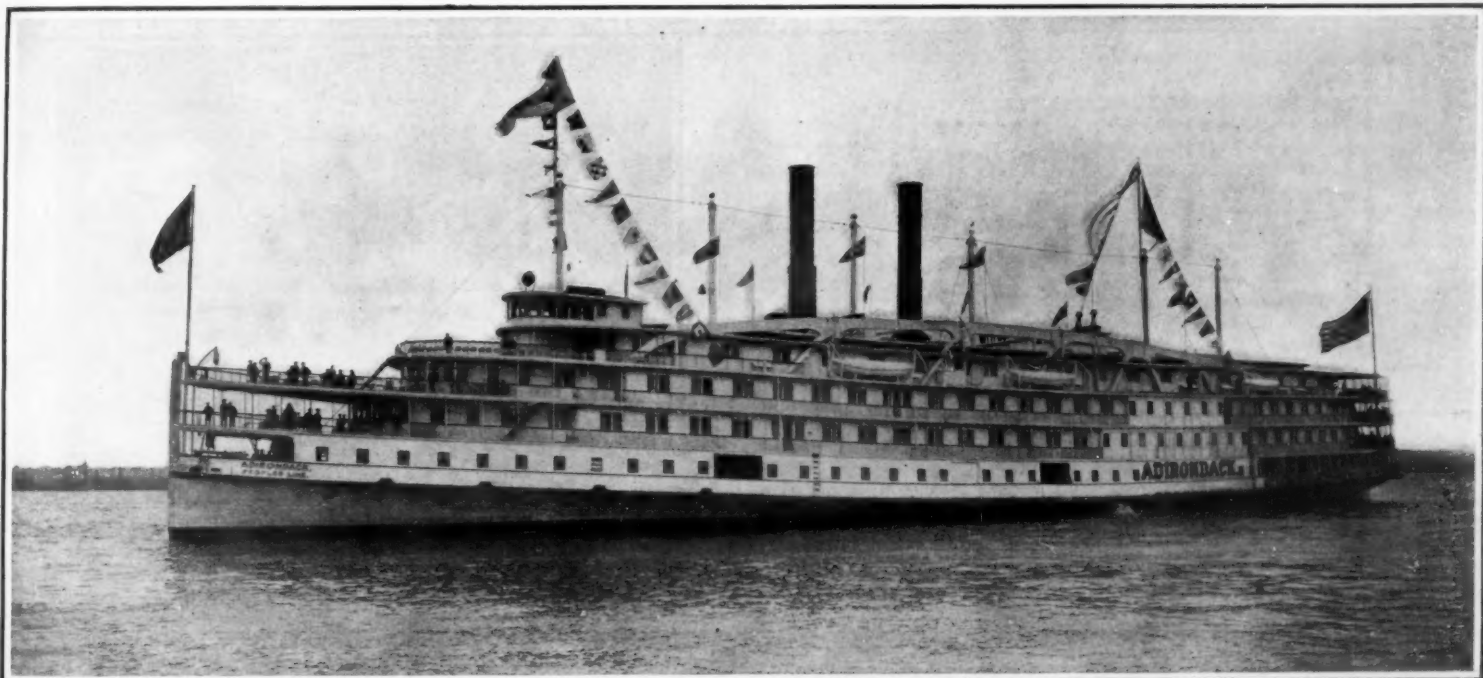
As originally built in 1880: Length, 285 feet; beam, 40 feet; depth, 11½ feet. Cylinder, 75-inch diameter; stroke, 12 feet. Subsequently lengthened to 325 feet. Has feathering paddle-wheels. On October 22d, 1880, ran from 22d Street, New York, to Poughkeepsie, 72½ miles, in 3 hours 8 minutes, at speed of 23.26 miles per hour. The "Albany" and the "New York" were the first large Hudson River boats to be built of iron.

THE "ALBANY," 1880.

gift for engineering, and being a man of wealth and the owner of works of his own, he approached all problems from the scientific standpoint, carrying on careful experimental work before he started the construction of the full-sized engine or boat. To him we owe the present open-skeleton walking beam, with its inclosing wrought-iron strap. In his new "Philadel-

another point of current practice in the possession of four separate boilers, one carried forward and one aft of the wheel house on the guards on each side of the vessel. The "four-pipe boats" with their two oscillating walking beams must have presented an odd appearance to the people of that day, who were accustomed to the one- and the two-pipe practice of the

to the facilities afforded by our magnificent rivers, to the keen competition between the various companies, and to the fact that then as now it is the fastest means of conveyance that wins the popular favor. Two of the swiftest boats of the day were the "Swallow," which was built for the original North River line, and the "Rochester," built in the same year, 1836,



Length, 412 feet; beam, 50 feet; draft, 8 feet. Beam engine, cylinder, 81-inch diameter, 12-foot stroke. Horse-power, 3,806. Speed, maximum 20¼ miles per hour. Contains 350 state-rooms. The dining-room can seat 300 guests. There are four decks for the accommodation of passengers.

THE "ADIRONDACK" FOR NIGHT SERVICE. 1896.

phia," 1826, he introduced the practice of carrying the boilers outside the boat upon the guards; and in her engine he introduced balanced poppet valves and wrought-iron side pipes. In the following year he introduced (in the "North America") for the first time the familiar truss or "hog frame" for stiffening the hull, a device which has survived in the Hudson River steamboat to the present day.

previous years. The next vessel to make a considerable cut in the running time to Albany after the performance of the "Sun" was the "Novelty," which on May 31st, 1832, ran from Albany to New York in nine hours and forty-seven minutes. On August 23rd of the same year, the "Champlain" made the run north in nine hours and forty-nine minutes.

The period from 1830 to 1840 was marked by a truly

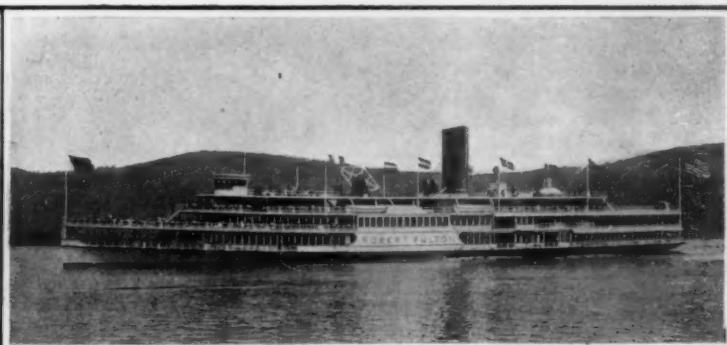
for the People's Line, which was started in 1835. The "Swallow," after frequent alterations to engines and hull, with a view to increase of speed, was finally equipped with a cylinder of the huge diameter for those days of 52 inches, and the "Rochester" with one of 50 inches diameter. The particulars of these boats as given by Morrison show to what an advanced stage

(Continued on page 227.)



Length, 390 feet; beam, 43 feet; width over guards, 82 feet; draft, 7½ feet. Inclined engine; one 45-inch high pressure, two 70-inch low pressure cylinders, with 7-foot stroke. Steam, 170 pounds. Speed on trial trip, 24.5 miles per hour. Has six decks, four of which comfortably accommodate 5,000 passengers.

THE "HENDRICK HUDSON," 1906. DAY SERVICE.



Length, 348 feet; beam, 42 feet; draft, 7½ feet. Beam engine, cylinder 75-inch diameter by 12-foot stroke. Has feathering paddle wheels. This vessel has the finest underwater body of all the Hudson River boats. Her maximum speed is 23¼ knots.

THE "ROBERT FULTON," 1909. DAY SERVICE.

## AMERICAN STEAMBOATS PRIOR TO THE "CLERMONT."

It is one of the estimable qualities of Robert Fulton that, in spite of the obvious temptation so to do, consequent upon his brilliant success with the "Clermont," he never claimed the distinction of being the original inventor of the steamboat. He was perfectly familiar with the ingenious work in the development of steam navigation which had been done both in the United States and in Europe during the two decades preceding the successful trip of the "Clermont." He had intimate knowledge of the previous history of the art; he was personally acquainted with the more successful inventors; and, as a guest, had made trips on at least one of the more successful boats. The present celebration, so far as Fulton is concerned, is held in honor of the successful inauguration of practical commercial steamboat navigation on the Hudson River. There is glory enough, surely, in this to make a fitting crown for the life work of one man. Were Fulton in our midst to-day, he would be among the first to do justice to the work of his predecessors and contemporaries, in other times and on other waters.

It is impossible, within the limits of the present article, to describe at any length the dozen or more steamboats, big and little, which were built and tried

1790 was placed in regular service on the Delaware as a packet, its sailing dates being advertised in the local press.

The sixth steamboat, a stern-wheeler, built by Capt. Samuel Morey of Connecticut, sailed from Hartford to New York, with Chancellor Livingston and others on board, in 1794.

The seventh steamboat, by Fitch, tried on the old

velt, John Stevens, and Chancellor Livingston, had side chain wheels driven by a steam engine. It was tried successfully in October, 1798, and with the Spanish Minister on board as a guest made three miles an hour.

The twelfth steamboat, built by Col. John Stevens, was a 25-foot flat-bottomed boat, which was driven by a screw propeller on the Hudson River at a speed of four miles per hour in 1803 and 1804.

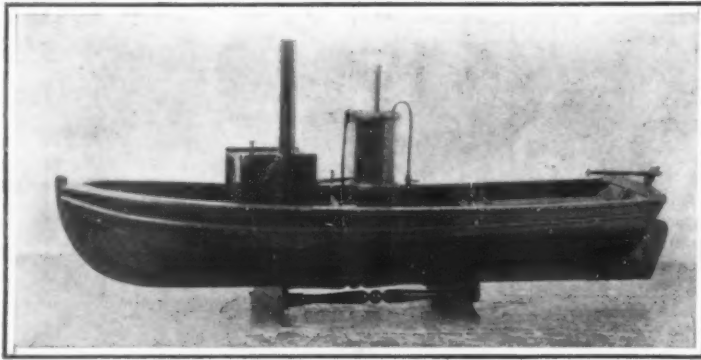
The thirteenth steamboat, built in 1804 by Stevens, was propelled by twin screws at a speed of seven to eight miles per hour, and made several trips on the Hudson River.

The fourteenth steamboat, built by Oliver Evans in 1804, was a large scow, or lighter, driven by a paddle wheel at the stern.

The fifteenth and last steamboat before 1807 to make a trip under her own steam was a large pirouge, with side paddle wheels, called the "Phoenix," built by Stevens in 1806-7, which, being debarred by Fulton's monopoly from navigating on the Hudson, subsequently steamed to Philadelphia by sea, and thus became the first steamship to make an ocean voyage.

It should be understood that although the above enumeration includes vessels that were actually moved by steam, no claim is made that they were

all of a practical character. Of the Americans who turned their attention to the development of the steamboat in the pre-"Clermont" period, two men, in our opinion, stand head and shoulders above their competitors, namely, John Fitch and John Stevens; the first, for

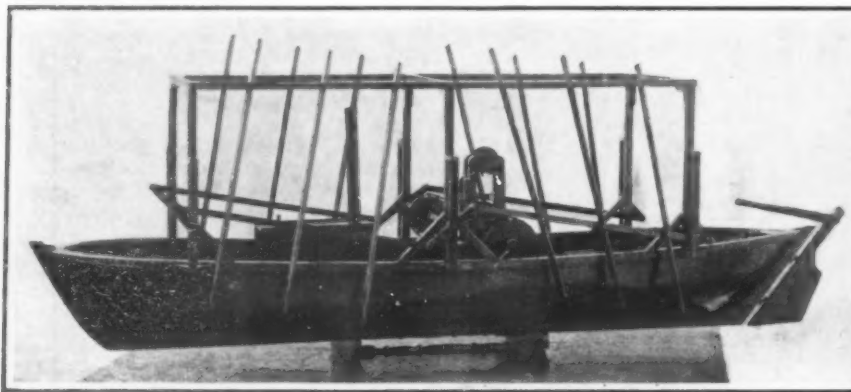


Rumsey's boat was propelled by a steam engine and pump which drew in water through the bottom and discharged it in a jet at the stern. Made four miles an hour in a short trial on the Potomac; but never reached the stage of practical operation.

(From photograph of the model in the Smithsonian Institution taken especially for the SCIENTIFIC AMERICAN.)

### JAMES RUMSEY'S STEAMBOAT OF 1787.

Collect Pond, now the site of the Criminal Court building and City Prison, New York, was driven by both paddle wheels and a screw propeller. Chancellor Livingston was aboard on this trip, and a very crude model of the boat, shown in the accompanying illus-



This boat made six miles an hour on the Delaware. It was propelled by vertical paddles, driven in sets of three. This crude model was made from memory in 1852 by a witness of the trials of the boat on the old Collect Pond, New York city.

(From photograph of the model in the Smithsonian Institution.)

### JOHN FITCH'S STEAMBOAT OF 1787.

with varying degrees of success in America prior to 1807. We must content ourselves with the following summary (based on Preble's history) of these early efforts, followed by a brief sketch of the remarkable work of Fitch and Stevens.

The first boat successfully propelled by steam in

tration, is now in the keeping of the New York Historical Society.

The eighth boat, by Morey, was tried on the Connecticut River in 1797.

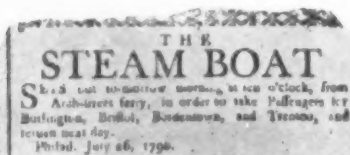
The ninth steamboat was built to plans of Chancellor Livingston by a Mr. Nisbet, and tried at De Koven's Bay, south of Tivoli, in March, 1798.

The tenth steamboat was a model side-wheel vessel built by Fitch and tried on the Ohio in 1798.

The eleventh boat, built and designed conjointly by Nicholas Roose

### JOHN FITCH'S STEAMBOAT OF 1796.

the reason that as far back as 1790 he placed on the waters of the Delaware a steamboat which ran on a regular schedule, was advertised extensively in the local papers, and carried freight and passengers at specified fares; the latter, because he was the first to apply the screw propeller as the sole means of pro-



#### Gray's Garden

Photograph of advertisement in the "Federal Gazette" of Philadelphia, July 26th, 1790.

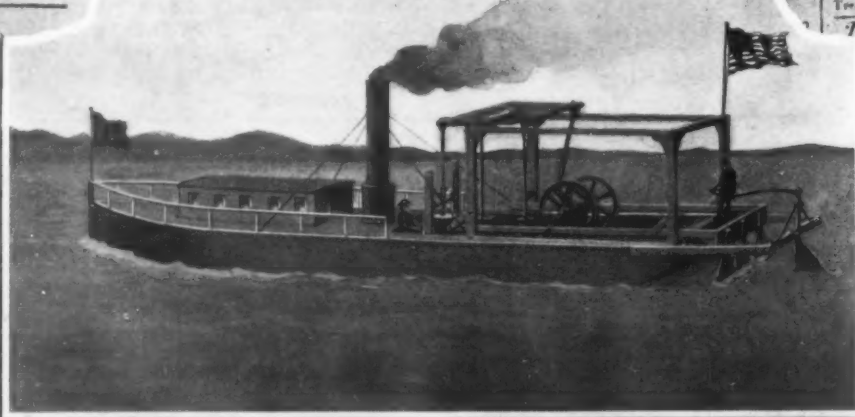
America was one built by John Fitch, which was tried on the Delaware, July 27th, 1786.

The second American steamboat, also built by Fitch, was tried on the Delaware in 1787.

The third boat, built by James Rumsey, and driven by a water jet, was operated at Shepards-town on the Potomac, September 3rd, 1787.

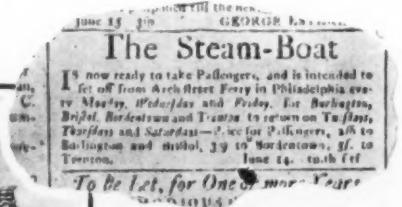
The fourth steamboat, built by Fitch, ran from Philadelphia to Burlington in 1788.

The fifth steamboat, also built by Fitch, made eight miles an hour over a measured course at Philadelphia in 1789, and in



This boat, 60 feet long, driven by an engine with cylinder 18-inch diameter, designed and built by Fitch, was put in regular service, advertised in the Philadelphia papers, and for three months in 1790 sailed according to schedule between Philadelphia, Trenton, and way points. Its average speed was 7 miles an hour. It was propelled by paddles at the stern.

### JOHN FITCH'S STEAMBOAT, WHICH SAILED REGULARLY BETWEEN PHILADELPHIA AND TRENTON IN 1790.



Photograph of advertisement in the "Pennsylvania Packet" of Philadelphia of June 14th, 1790.

PELLING a boat; that he used tubular boilers and high-pressure steam; and that he was the first to adopt that system of twin propellers which subsequently became the standard method of propulsion throughout the world.

#### JOHN FITCH.

John Fitch stands out as a splendid type of a large class of ingenious, courageous, but poor inventors, who did so much to promote the industrial development of the country during the early years of the young republic. Born at



Windsor, Conn., on the 21st of January, 1743, in moderate circumstances, he learned the trade of clock making, and at twenty-six years of age moved to New Jersey and then to Philadelphia, where he became a strong partisan on the American side in the dispute between the colonies and Great Britain. He was made lieutenant of a company raised at Trenton, but ultimately he found his sphere of usefulness in the gun factory at Trenton. When Washington crossed the Delaware Fitch moved with the Continental troops to Pennsylvania. In 1780 he was appointed a deputy surveyor, and ultimately struck out westward for the purpose of surveying lands lying beyond the Ohio River. In 1781 he started for Fort Pitt, now Pittsburg. Later he was captured by the Indians, endured severe privations, and was finally carried by them to Canada, where he fell into the hands of the British. After his liberation he again took up the work of surveying the unknown lands of the West; and ultimately, in 1785, turned his attention to his great life-work of inventing a boat to travel by the power of steam. Beyond a natural aptitude for mechanics, Fitch was entirely unfurnished for this difficult task. Although steam-engine building was a recognized trade in England, and had been for many years, there were at this time but three steam engines in the whole of America, and the country was absolutely without suitable means for steam-engine manufacture. In his quaint 500-page manuscript autobiography, now in the Philadelphia Library, Fitch writes: "Although it was not to my credit, I did not know that there was a steam engine on earth when I proposed to gain a force by steam." He read up all the scant literature he could obtain on the subject, formulated his plans, and on September 27th, 1785, presented a drawing and model of his boat to the American Philosophical Society at Philadelphia. The model shows the method of propulsion by an endless chain provided with paddle boards. He endeavored to interest Franklin and Gen. Washington in his plans, neither of whom, however, gave him much encouragement. He formed a company, and on March 18th, 1786, secured from the Legislature of New Jersey the exclusive rights for steam navigation in that State. It was at this time that he associated himself with Henry Voight, a clock-maker of unusual mechanical ingenuity and skill. The task which these men had set themselves was Herculean. There were no machine shops nor the necessary tools for the accurate work required; and through the subsequent years of experimentation they had to feel their way, amid a thousand discouragements of poverty and ignorance, to the final success which crowned their efforts five years later. They first built a model steam engine with a cylinder of one inch diameter, which was too small for a demonstration. Then a new model, with a 3-inch cylinder engine, was erected in a small skiff, and a trial was made with Fitch's endless chain paddle-boards, but without success. Then it occurred to Fitch to move the boat by oars or paddles, working on the side, and moved by cranks operated by the engine. This was tried on the skiff with the 3-inch engine, and on the 27th of July, 1786, the first boat propelled by steam in America made its trial trip successfully on the Delaware. Encouraged by the passage of a law by the State of Delaware in 1787, securing

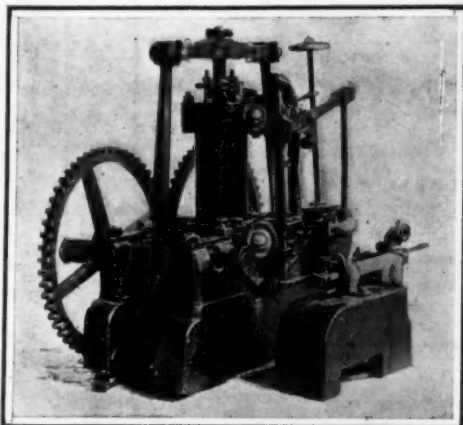
Fitch's right to the invention, fresh advances of money were made by the shareholders, and a boat 12 feet wide and 45 feet long was equipped with an engine having a 13-inch cylinder. After much experimental work with the condensers, this boat, on August 22nd, 1787, was propelled on the Delaware in the presence of practically all the mem-



Col. Stevens built the first successful steamboat driven entirely by the screw propeller; the first twin propeller boat; and the first steamboat to make an ocean voyage.

COLONEL JOHN STEVENS; 1749-1838.

bers of the Convention who were then sitting in Philadelphia to frame the Federal Constitution. Certificates of perfect success of this trial were given by Gov. Randolph of Virginia, David Rittenhouse the astronomer, and other notable men. An engraving and description of the boat made from the plans were published in the Columbian Magazine for December, 1786.



Cylinder, 4 1/2-inch diameter by 9-inch stroke. Two connecting rods to two shafts which are geared together and turn in opposite directions. Valves are two-way cocks, operated by a crank on inboard end of one of the crank shafts.

ENGINES OF STEVENS'S TWIN-SCREW STEAMBOAT OF 1804.



Round shank could be turned in the hub to change pitch.

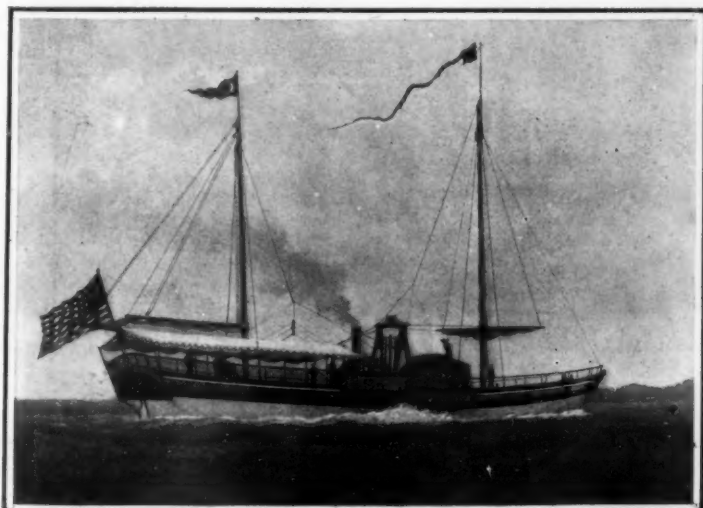
STEVENS'S ADJUSTABLE PROPELLER BLADES

The cylinder was double-acting and condensing. Fitch introduced the jet condenser, which he believed to be original with him, although it had been previously invented in Europe. The boat was driven by six pairs of oars, or paddles, which were pivotally connected in sets of three to four horizontal driving bars, operated by cranks on crank disks driven by the engine. Fitch preferred these paddles to the paddle wheel, because he considered that the latter involved a great waste of power, due to the obliquity of the wheels on entering and leaving the water. Fitch's objection to the paddle wheels was theoretically correct; and its inefficiency was not corrected until the invention, half a century later, of the feathering paddle wheel.

The third steamboat built by Fitch was a much larger craft, and was driven by a greatly improved engine. The new boat was 60 feet in length and 8 feet in beam. Its engine, also, had 12-inch cylinder; but as the result of an improved condenser, designed by Fitch, it developed considerably more power than the engine in the preceding boat. Furthermore, it should be mentioned that this was the first steamboat equipped with a tubular boiler, the invention of Voight. The oars, or paddles, were removed from the sides and placed at the stern. Toward the close of July, 1788, she made the trip of twenty miles from Philadelphia to Burlington, and on the 12th of October she made the same trip in three hours and ten minutes with thirty passengers on board. The boat continued in more less experimental operation during 1788 and 1789. The story of the troubles of Fitch and Voight in the endeavor during this time to perfect their engine, as contained in Fitch's autobiography, is of absorbing interest. No less than seven different condensers were tried and rejected. Finally an 18-inch steam cylinder and a jet condenser of Fitch's design were installed, and at last, in the words of Fitch, "On the 16th of April (1790) got our work completed, and tried our Boat again; and altho the wind blew very fresh at the north east, we reigned Lord High Admirals of the Delaware, and no boat in the River could hold its way with us, but all fell astern, although several sail boats, which were very light, and heavy sails, that brought their gunwales well down to the water, came out to try us."

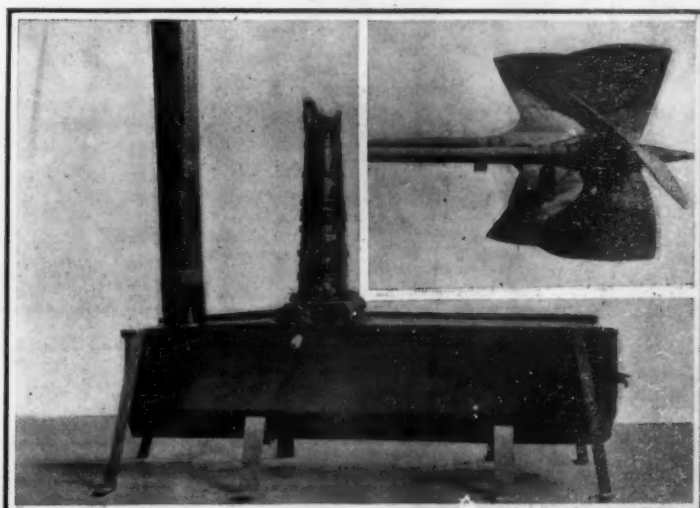
Shortly afterward, Rittenhouse the astronomer, Dr. Ewing, Gen. Irvine, and others were favored with the novel experience of a steam voyage; and now, at last, public journals began to give well-deserved notice to the successful efforts of these indefatigable inventors. The following paragraph was published in the Gazette of the United States, May 15th, 1790, and widely recopied throughout the Union: "Burlington, May 11, 1790. The friends of science and the liberal arts will be gratified in hearing that we were favored, on Sunday last, with a visit from the ingenious Mr. Fitch, accompanied by several gentlemen of taste and knowledge in mechanics, in a steamboat constructed on an improved plan. From these gentlemen we learn that they came from Philadelphia in three hours and a quarter, with a head wind, the tide in their favour. On their return, by accurate observations, they proceeded down the river at the rate of upwards of seven miles an hour." Subsequently, on June 16th, Gov. Thomas Mifflin and nine members of the

(Continued on page 222.)



Debarred by the Livingston-Fulton monopoly from navigating the Hudson, the "Phoenix" went by sea to Philadelphia and was operated on the Delaware. (This was the first steamboat to make an ocean voyage.)

STEVENS'S STEAMBOAT THE "PHOENIX," 1807.



Boiler has 28 tubes 1 1/2-inch diameter and 18 inches long; fourteen projecting from each side of the central rectangular chest. (From photograph by the courtesy of the Smithsonian Institution.)

MULTI-TUBULAR BOILER AND TWIN SCREWS OF THE STEVENS BOAT OF 1804.

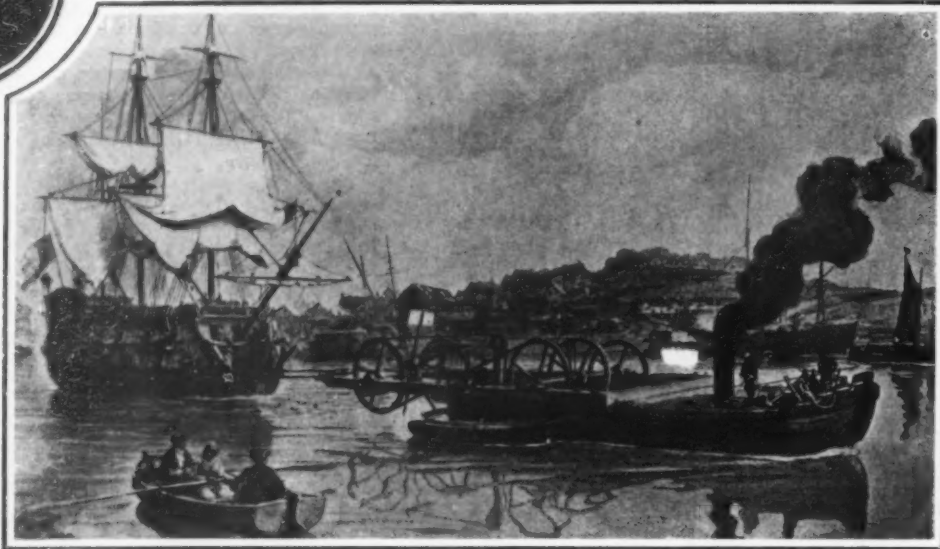


Fig. 1.—JONATHAN HULLS'S PROPOSED BUT NEVER BUILT STEAM TUG. 1737.

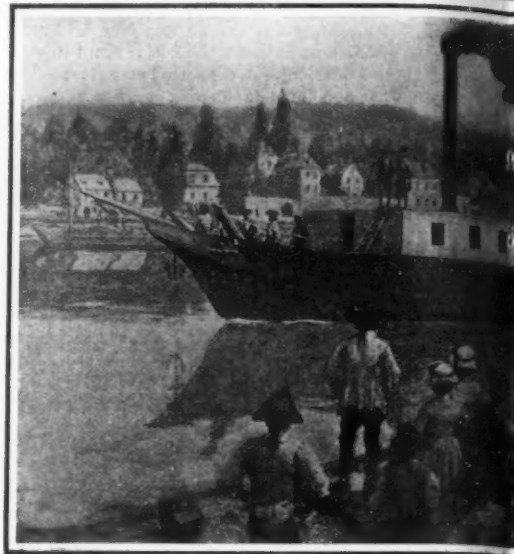


Fig. 2.—THE MARQUIS DE JOUFFROY'S PADDLE STEAMER.

FIG. 1.—In 1734 Jonathan Hulls, yeoman, of Campden, Gloucestershire, patented and published a complete description of a practical steam-tug. The tug had a single-acting steam-cylinder, 30 inches in diameter, which in its inward stroke lifted a weight equal to one-half of its effective pull. The energy of this weight in its descent during the return stroke gave the engine a double action and the reciprocating motion of the piston gave continuous rotation by a ratchet gear to a paddle-wheel at the stern.

FIG. 2.—The drawing is based on a sketch at South Kensington Museum taken from a French print published in 1810. In Paris there exists a document declaring that on July 15, 1783, the vessel was propelled by steam for fifteen minutes against the current of the Saone. The boat was 150 feet long with 15 feet beam and 3 feet 2 inches draft. It had two paddle-wheels, turned by a single horizontal steam-cylinder, driving through a ratchet mechanism.

FIG. 3.—Patrick Miller, a wealthy Scotch banker, built a double-hulled boat which he propelled by a paddle-wheel, placed in the channelway between the hulls and operated by men by means of cranks and winches. Symington subsequently (Fig. 5) substituted steam for man power.

FIG. 4.—This vessel, designed by Symington for the Forth and Clyde canal, in March, 1802, towed two 70-ton barges for 19½ miles against a hard wind at the rate of 3½ miles an hour. The horizontal engine, direct-connected from cross-head to paddle-wheel shaft, was many decades ahead of its time. It embodies all the essential features of the modern horizontal engine, and mechanically was a great advance upon the Watt beam engines of that day.

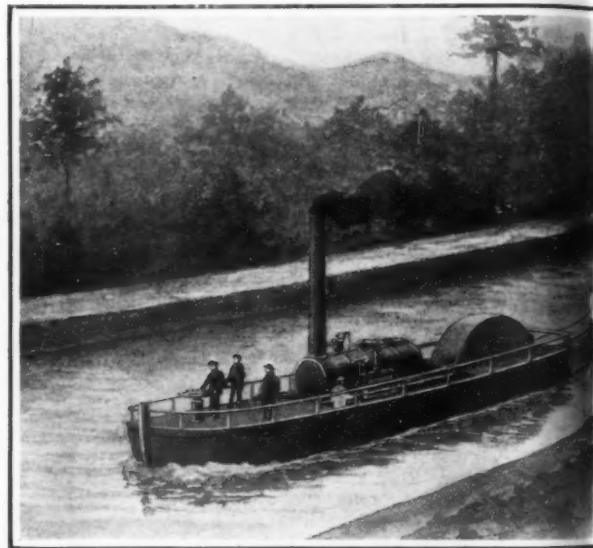


Fig. 4.—WILLIAM SYMINGTON'S STEAMBOAT "CHARLOTTE DUNDON".



Fig. 5.—SYMINGTON AND MILLER'S DOUBLE-HULLED STEAM VESSEL. 1788.

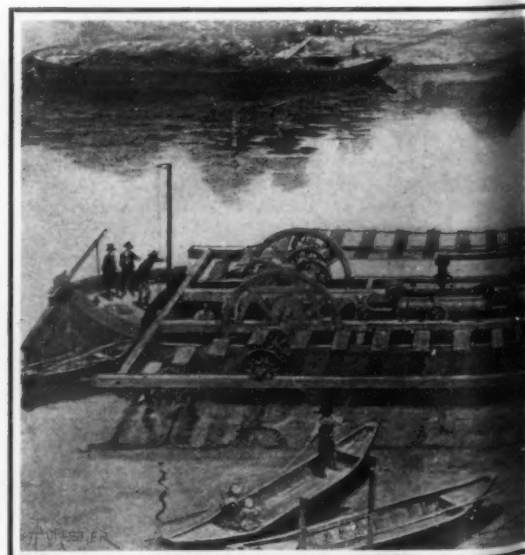
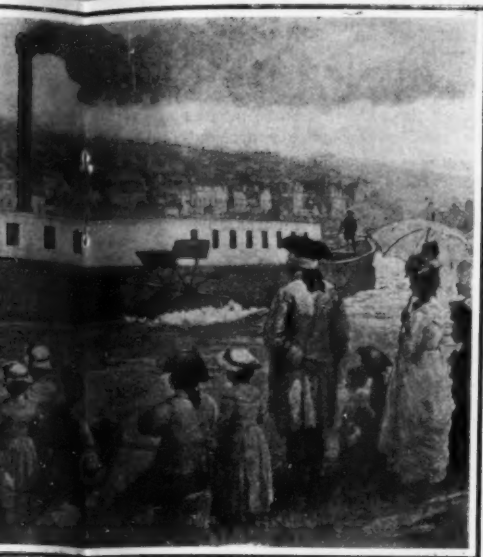


Fig. 6.—DESBLANC'S STEAMBOAT TRIED IN THE FORTH AND CLYDE CANAL. EUROPEAN STEAMBOATS PRIOR TO 1800.

Figs. 4 and 7 by our own artist; the others by the artist.







PADDLE STEAMBOAT ON THE SAONE. JULY 15TH, 1783.

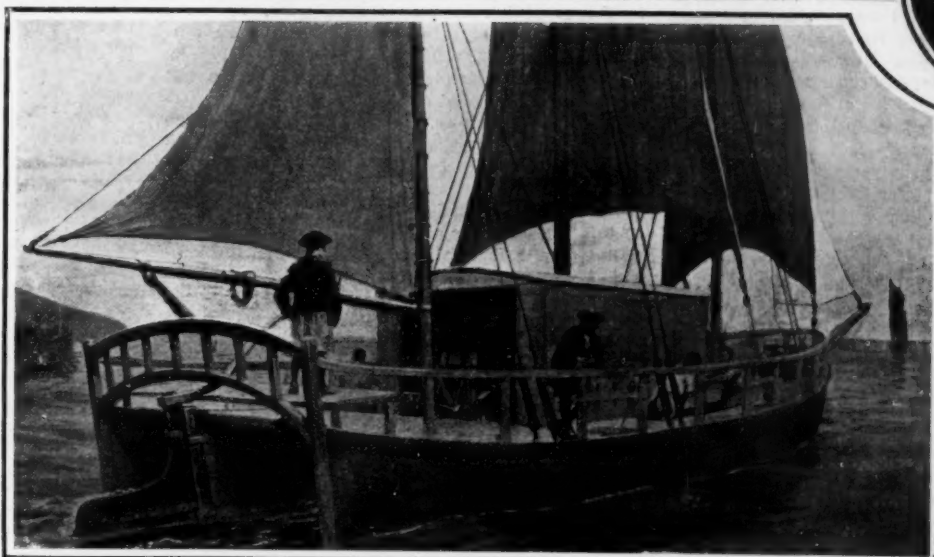


Fig. 3.—PATRICK MILLER'S DOUBLE-HULLED PADDLE BOAT DRIVEN BY MAN POWER. 1786.

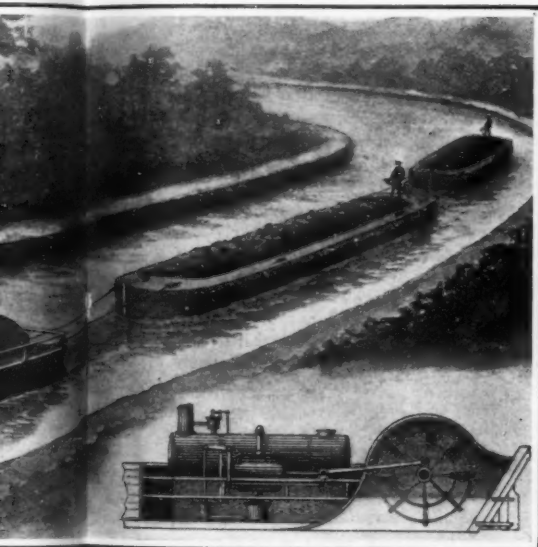
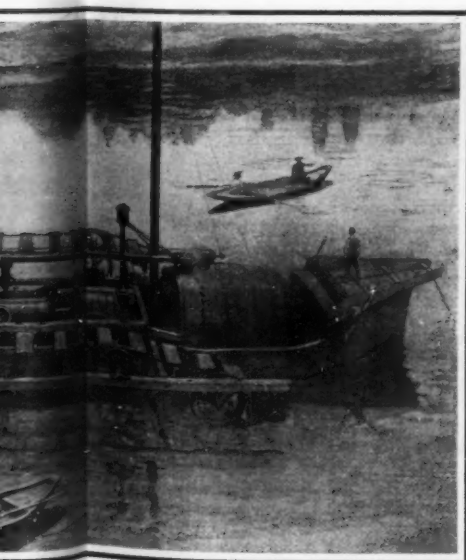


FIG. 5.—The engine for this boat was built in 1788 by William Symington for Patrick Miller. It was placed on one deck of a double-hulled pleasure-boat, and the boiler was put on the other deck. The boat ran on Dalswinton Loch at the rate of five miles an hour. The engine had two vertical open-topped cylinders with pistons connected by two chains with a drum turning in opposite directions alternately. Chains from the central drum turned two pulleys attached to the horizontal paddle-shafts, with ratchet teeth round their inner flanges, and these drove the paddle-wheel continuously in one direction.

FIG. 6.—The hull of the vessel was built like a barge. The horizontal motion of the cylinders was converted into circular motion by a ratchet gear acting upon the axle of the fly-wheels. The floats of the paddle were arranged on parallel chains, and traveled like the buckets of a dredger. As the floats of the paddle came out of the water they feathered like an oar.

FIG. 7.—This illustration, drawn from plans filed by Fulton with the French Commission appointed by Napoleon I. to investigate his invention, possesses special interest, because it undoubtedly formed the model on which the engines of the "Clermont" were designed. The engine consisted of an upright cylinder, cross-head, vertical side rods connecting to a bell-crank lever, from which the paddle-wheel crank-shaft was driven by a connecting rod. It made 3½ miles on its trial trip.

TE DUNDY TOWING ON THE FORTH AND CLYDE CANAL. 1802.



AT TRIED ON THE RIVER DOUBS. 1802

# PRIOR TO THE "CLERMONT."

thers by the of the Illustrated London News.

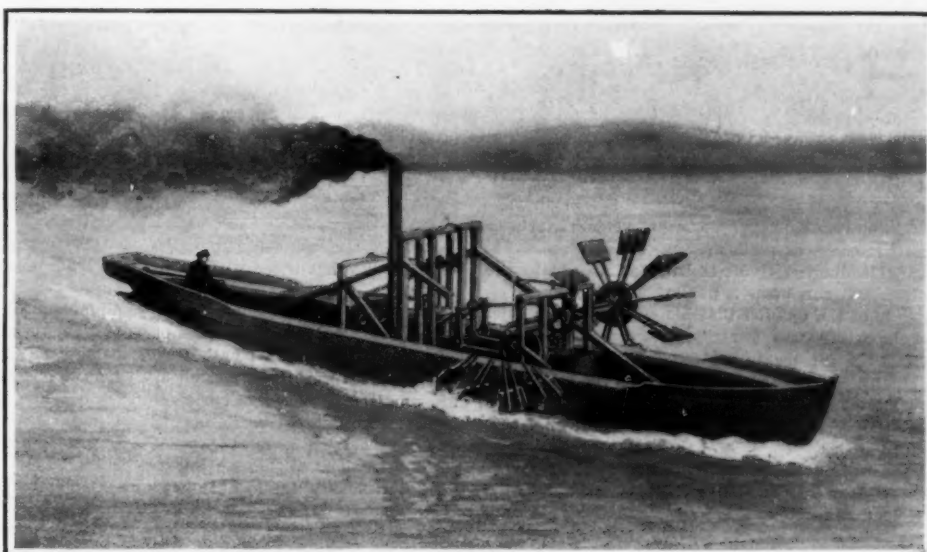
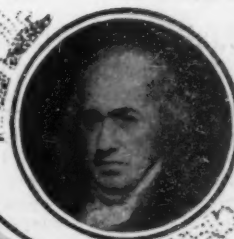


Fig. 7.—FULTON'S STEAMBOAT BUILT AND TRIED ON THE SEINE AT PARIS. JULY, 1803.

[SEE PAGE 222.]



## EUROPEAN STEAMBOATS PRIOR TO THE "CLERMONT."

As in America, so in Europe, the quarter of a century preceding the successful inauguration of steamboat service on the Hudson River was a period of extraordinary interest among inventors in the possibilities of steamboat navigation, during which a great amount of thought and experimental work was devoted to the development of a successful steam-driven vessel. In the present chapter we shall touch lightly upon those inventors who merely drew up plans, took out patents, and made more or less successful models of steamboats; our attention will be devoted more specifically to the clearly-recorded and well-authenticated instances, in which steamboats of useful size were actually propelled by steam.

Following this plan, we may dismiss at once the oft-asserted claim that a vessel of some 200 tons, built by Blasco de Garray, a native of Biscay, was propelled by steam at Barcelona in Spain in the year 1543. Careful search by investigators has revealed two letters, signed by Garray and dated 1543, describing experiments with different vessels, both of them moved by paddle wheels turned by men. There is no mention of the use of steam, or anything to indicate that this motive power was contemplated.

The Marquis of Worcester published a book in 1663, in which mention is made of an engine, and of the ability of the inventor to make the vessel which carried it "go against the stream which the more rapid it is the faster it shall advance." His patent, however, contains no suggestion that he had any idea of using steam.

Although the name of no inventor in the early part of the eighteenth century is more closely associated with the design of the steamboat than that of Jonathan Hulls, there is no proof that he ever built and operated one. At the same time, Hulls was a man of unusual intelligence and of considerable mechanical skill. His patent, taken out in 1736, describes the invention as "a machine for carrying ships and vessels out of, or into, any harbor or river against wind and tide." The following year he published a pamphlet in London describing his invention; and it is curious that, like many early experimentalists, he considered that its greatest usefulness would be found in the towing of vessels. The illustration of his boat, given on page 220, was drawn from his very complete description of the mechanism of the boat, and Admiral Preble, of the United States navy, in his work "On the Origin and Development of Steam Navigation," says that "there can be no doubt of his having been the first inventor of an ingenious and practicable mechanism for propelling vessels by a condensing steam engine and by paddle wheels"; and this, be it remembered, was as far back as 1736. Writing over a quarter of a century ago, again the same author says: "The following doggerel is still the burden of a common street ditty among the boys of Campden of Gloucestershire, Hulls's native place:

Jonathan Hulls,  
With his patent skulls,  
Invented a machine  
To go against wind and stream;  
But he, being an ass,  
Couldn't bring it to pass,  
And so he was ashamed to be seen."

Truly, a prophet is not without honor save in his own country.

It is a disputed point whether to Denis Papin, the great French engineer and professor of mathematics at the University of Marburg, is due the credit of being the first to make a steamboat run upon a public waterway. Preble, however, is of the opinion that his correspondence with Leibnitz, which was brought to light during the latter part of the nineteenth century, fully proves that Papin actually constructed a steamboat which he ran upon the river Fulda in 1707. It is certain that he met with the seemingly inevitable ridicule and abuse. Disgusted with the conduct of the Hessians, he determined to go to London in his steam vessel, and descended the Fulda as far as Munden, where the boatmen laid violent hands upon him, and destroyed his little craft.

Next to Papin comes the Marquis de Jouffroy, who in 1781 built a steam vessel 150 feet in length and 15 feet in beam, which, according to a document now in Paris, was propelled by steam for fifteen minutes against the stream.

### WILLIAM SYMINGTON.

The credit for the invention and construction of the first steamboat to be successfully applied in Europe to useful navigation is due a Scotch engineer, William Symington, who attacked the problem on original lines, and produced a vessel, the "Charlotte Dundas," which in many respects was half a century in advance of the state of the art. Symington was born in Scotland in 1764. Educated for the church, his taste for mechanical philosophy, he tells us, led him to direct his studies

to the exercise of the profession of a civil engineer. He obtained patents for several improvements in the steam engine, and designed a steam carriage, which in 1786 he submitted to several learned and scientific men in Edinburgh. Here he met Patrick Miller of Dalswinton, a wealthy banker, who informed Symington that he had "spent much time in making experiments as to the propelling of vessels upon water by using wheels in place of sails or oars. These wheels he had put in motion, applying the strength of men to the turning of a handle or winch." Symington told Miller that he believed a steam engine might be constructed for the purpose, and he proposed that favorite method with early steamboat inventors, of communicating a rotary motion to the paddle by the alternate action of ratchet wheels. The first experiment was made with a two-cylinder engine, the cylinders being of 4 inches diameter and 18-inch stroke. It was installed on a double-keel vessel, and tried on the Dalswinton estate in 1788, with satisfactory results. The next experiment was upon a larger boat, 60 feet in length, belonging to Miller, which was already equipped with man-operated paddle wheels. In this vessel Symington placed a two-cylinder engine, each cylinder being of 18 inches diameter and 3-foot stroke; and in October, 1789, with Miller and several prominent business men and engineers on board, the boat was driven at a rate of five miles an hour in still water. The engraving on page 220 is based on the original plans of this boat, as given by Symington. At this point, Miller retired from business to devote himself to his estate at Dalswinton; but in the year 1800, Lord Dundas, one of the principal owners of the Clyde Canal, requested Symington to take up his experiments with the steamboat, and spent about \$35,000 in this work. With sufficient capital assured to give him a free hand, Symington designed an entirely new boat and engine, called the "Charlotte Dundas." An examination of the drawings of the vessel, as shown on pages 220 and 221 of this issue, proves that Symington was an engineer of decidedly original genius. Even at that early day, his mechanical sense objected to the cumbersome overhead working beam, and in a letter at that period he criticises the cylinder erected in a vertical position and the heavy working beam, and other heavy and complicated apparatus of the old steam engine, and explains how, by changing the position of the cylinder and "by coupling to the end of the piston rod a crank and arm," he "reproduced a rotary motion without the intervention of a lever or beam." In other words, Symington in the engine of the "Charlotte Dundas" originated the modern horizontal reciprocating engine, which was destined to become the predominant type for steamboat, locomotive, and stationary engines, and continued to be such throughout the middle period of the history of the steam engine. The cylinder was double acting, 22 inches in diameter and with a stroke of 4 feet. It was direct-connected to the crankshaft of a paddle wheel at the stern of the boat. The account of the experiment, as given in his own narrative, which has been confirmed by others, is as follows:

"Having previously made various experiments, in March, 1802, at Lock Twenty-two, Lord Dundas, the great patron and steamboat promoter, along with Archibald Spiers, Esq., of Elderslee, and several gentlemen of their acquaintance being on board, the steamboat took in drag two loaded vessels, the 'Active' and 'Euphemia,' of Grangemouth, Gow and Elspine, masters, each upwards of seventy tons burden, and with great ease carried them through the long reach of the Forth and Clyde Canal at Port Dundas, a distance of nineteen and a half miles, in six hours, although the whole time it blew a very strong breeze right ahead of us; so much that no other vessel could move to windward in the canal that day but those we had in tow."

Since the object of Lord Dundas in employing Symington was to have him devise some cheaper means of towing canalboats than the existing method by horses, it would look as though the future of the steamboat was assured; but, unfortunately, the other proprietors of the canal objected to the use of steamboats, urging that the waves set up would wash away the canal banks. Therefore, nothing further was done. Subsequently, Symington was introduced by Lord Dundas to the Duke of Bridgewater, who was responsible for the introduction of canals into England. Symington impressed him so favorably that he gave him an order to build eight boats similar to the "Charlotte Dundas" for service on his canals, but the death of the Duke shortly afterward led to the cancelling of the order.

Among the many methods of applying the power of the engine to propel the boat that were tried by the early inventors, one of the most popular was to use an endless chain of paddle boards, traveling over wheels or pulleys at each end of the boat, the paddles being submerged as they passed toward the stern, and being carried clear of the water as they returned toward the bow. Of this type was Desblanc's steamboat, which was tried on the river Doubs in 1802. The arrangement of the engine and the chain of paddles is shown very clearly in the engraving on pages 220 and 221.

The engine was horizontal, and the reciprocating motion of the piston was converted into rotary motion by means of a ratchet gear acting upon a spur wheel upon the main driving axle.

## AMERICAN STEAMBOATS PRIOR TO THE "CLERMONT." (Concluded from page 219.)

Council, after a trip on the Delaware, were so greatly pleased as to present Fitch with a suit of colors for his boat.

The new venture was now ready for commercial exploitation. A schedule of sailing dates and fares was drawn up, and during the following three months there appeared in the local papers twenty-three advertisements announcing the times of sailing. The routes covered were to Trenton, thirty miles; to Burlington, twenty; to Chester, fifteen; and to Wilmington, thirty miles. During these three months "The Steamboat," as she was popularly called, ran in regular passenger service for a total distance of between 2,000 and 3,000 miles. Limitations of space prevent any further quotation of the certificates and eulogies given by prominent men of the day. We present engravings of two of the advertisements of 1790, photographed for the SCIENTIFIC AMERICAN from the files of the Pennsylvania Packet and the Federal Gazette, by the courtesy of Mr. Abbott, the curator of the Philadelphia Library.

In view of this crowning success to the labors of Fitch and his associates, the story of the rest of his life is truly tragical. His attempt to build another and larger vessel failed for want of financial support. Had some influential, wealthy, and far-sighted patron come to Fitch's assistance at this time, there can be little doubt that the advent of successful commercial steamboat navigation would have been hastened by twenty years. But it was not to be. Discouraged and embittered by failure to secure recognition and support, Fitch, after an abortive trip to France, wrote an account of his life and experimental work, which he delivered to the librarian of the Philadelphia Library, with instructions that it be not opened for thirty years; and then, retiring to Bardstown, Ky., he ended his unfortunate life by committing suicide.

### JOHN STEVENS.

The claim of Col. John Stevens to a foremost position among those who contributed to the early development of the steamboat is based upon his recognition of the value of the screw propeller, of the multitubular boiler, and of high-pressure steam. Like Fitch, Stevens was possessed of great mechanical ability; and to this was added the advantage of wealth and education. His claim to have built the first steam screw propeller boat to navigate the waters of any country we consider to be indisputable.

After some preliminary experiments, as recorded earlier in the present chapter, Mr. Stevens designed an entirely new engine and boiler, differing from anything that had yet been attempted either here or in Europe, and erected it in a 28-foot boat, which made many successful trips at speeds of between seven to eight miles an hour on the Hudson River. The twin screws, engine, and the boiler are still in existence, and are now at the Smithsonian Institution, Washington. The accompanying illustrations are reproductions from photographs of this exhibit made especially for the SCIENTIFIC AMERICAN by the courtesy of the curator. The cylinder was of 4½ inches diameter and 9 inches stroke. Motion was transmitted from the overhead crosshead by two connecting rods to a pair of cranks, one on each propeller shaft. The cranks turned in opposite directions (to overcome the tendency of a single propeller to rotate the boat) and the cranks were maintained in their proper rotating position relatively to each other by means of two gear wheels on the propeller shafts. The reaction of the connecting rods against each other served the purpose of a parallel motion and maintained the piston rod in alignment. The valves consisted of two-way cocks, and they were driven by a crank on one of the propeller shafts, through the intermediary of a vertical rack and gear wheels on the spindles of the two-way cocks. The boiler is one form of the multitubular type invented by Col. Stevens. It has 28 copper tubes, 14 projecting from each side of a center rectangular chest.

Contemporary testimony to the successful operation of this boat is given in Stewart's "Anecdotes of the Steam Engine," published in 1829, and in an article by Dr. James Renwick contributed to Tredgold's "Treatise on the Steam Engine," published in London in 1838.

That John Stevens and his son, Robert L. Stevens, are to be credited with having built the first ocean-going steamship is proved by the well-authenticated voyage made by the "Phoenix" from New York to Philadelphia. The engines of the "Phoenix" were designed and built by Stevens. The accompanying illustration of this historic vessel is from a photograph of an old painting at the family home, Castle Point, Hoboken, N. J. Alluding to the above voyage, the late Mr. J. Scott Russell, the builder of the "Great Eastern," said that Mr. Robert L. Stevens was "undoubtedly the pioneer of steam navigation in the open sea."



# THE AMERICAN WALKING-BEAM ENGINE.

Looked at from the standpoint of the mechanical engineer, the most extraordinary fact in the story of the development of the Hudson River steamboat is the vitality of that early form of steam engine known as the walking-beam type. Although to-day its term of useful life lacks but a year or two of a century, and it is, therefore, actually as old as the Hudson River steamboat itself, and though it represents one of the earliest and crudest methods of changing the reciprocating movement of the piston into the rotary movement of the power shaft, the walking-beam engine is to-day the prevailing type of drive on the Hudson River. Most significant fact of all, when it came to the question of what type of engine to use on the "Robert Fulton," the latest of the Hudson River fliers, built this year, it was decided that, all things considered, the most suitable engine would be one of the kind which was first placed in a Hudson River boat in the year 1811.

In steam engine practice, one hundred years ago, the rocking or walking beam was the favorite method of connection between the piston rod and connecting rod. We are all familiar with the engravings of early stationary engines, particularly those used for pumping in city waterworks, in which a vertical steam cylinder transmitted its power to a cast-iron overhead rocking beam, which was carried upon cast-iron girders supported on cast-iron pillars of elaborate classic design. By the middle of the nineteenth century, this type was being discarded for the simpler horizontal engine; and to-day the few remaining walking-beam stationary engines are regarded with a strictly antiquarian interest.

In the development of the Hudson River steamboat, on the contrary, the beam engine proved to be so ideally adapted to the work, that it has held its place against the multi-cylinder, high-pressure, fast-running engine, with conspicuous success. In the first place, it was an easy engine to build; and, when once the foundries, machine shops, and forges had been built and a force of capable mechanics had become available, its first cost was low. The engine consisted essentially of a single cylinder, a walking beam, a connecting rod, the A-frame, which carried the main bearings of the walking beam, a jet condenser, a hot well whose piston was operated by connecting rods from the walking beam, and feed pumps operated from the same connecting rods as the hot well. Judging from early prints and descriptions, the engine was quickly developed to the identical form which it carries at the present time, the principal change being the substitution, in the past quarter of a century, of surface condensers for the early jet condenser.

The "Clermont," as we have shown elsewhere, transmitted the power from the cylinder to the crankshaft through a bell-crank lever. Subsequently, during the succeeding two decades, use was made of a steeple engine, in which a pair of rocking beams, carried low down in the boat, were used, or the crankshaft was placed immediately below the cylinder, with connecting rods coupled from the piston crosshead to the cranks. This type, however, soon gave way to the present form with an overhead walking beam mounted on a stout timber A-frame, whose footings were bolted

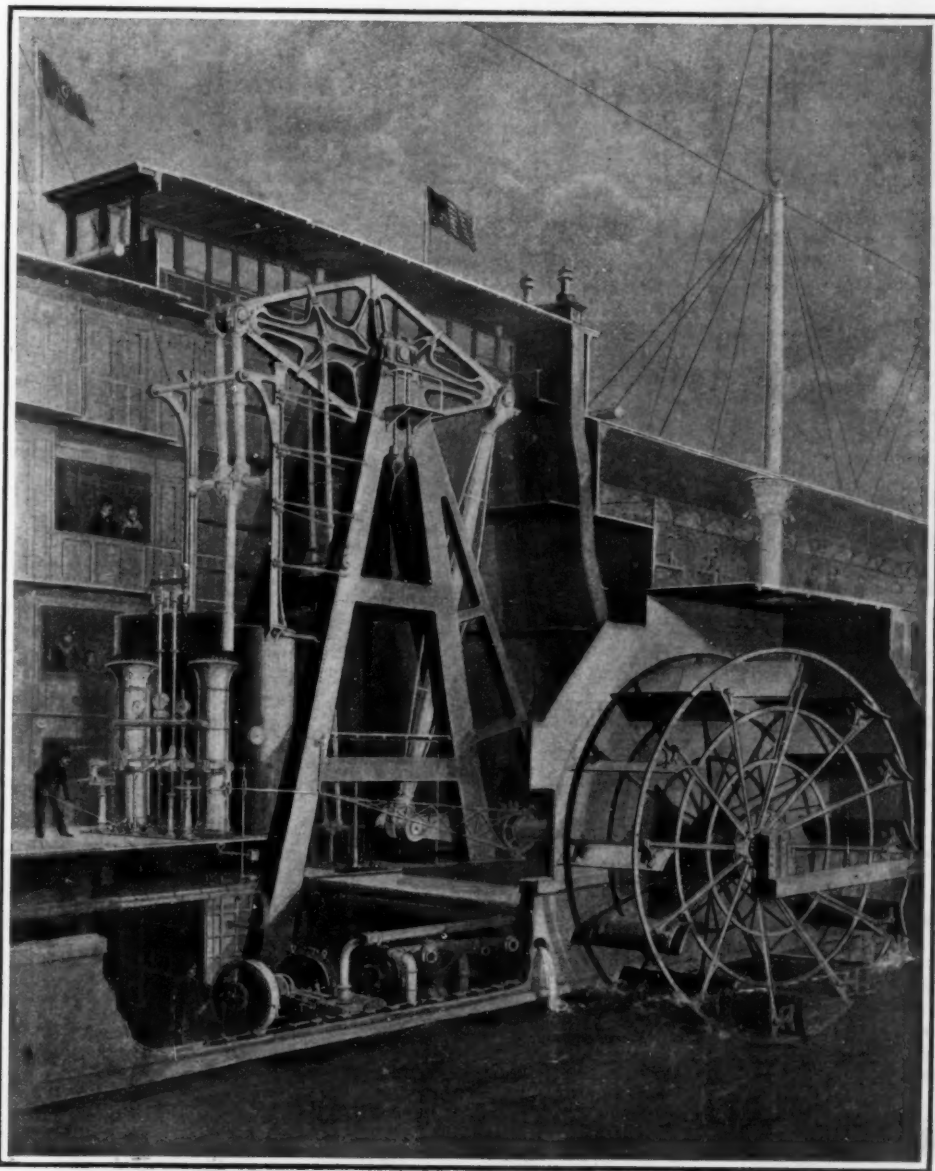
to the keelsons of the floor of the boat. The A-frame was built of massive timbers very strongly braced and bolted, and carried at its apex the main bearings of the walking beam. The guides for the crossheads were held in line by rods extending from the guides to the A-frame.

The boiler of the "Clermont" was made of copper and carried the low pressure of four or five pounds to the square inch. Copper was used because iron plates were not available; but eventually, when reliable boiler plate became available, iron boilers were introduced, and immediately higher steam pressures began to be used. Tubular boilers were introduced in 1830 on the "Novelty," and about the year 1840 wood gave place to anthracite coal. Concurrently with the increase in boiler pressures, a great advance was made in the size and power of the engines. The single cylinder of the "Clermont" was 24 inches diameter by 4 feet stroke. The "Chancellor Livingston" of 1816 had engines 44 inches in diameter by 5 feet

favorite drive for Hudson River steamboats, and its undoubted popularity among the directors of the companies and in the pilot house and the engine room, is largely due to the especial conditions under which the Hudson River service is operated. In the first place, the upper reaches of the Hudson are very shallow during several months of the summer, and it is desirable to keep the draft of the boats as small as possible; conditions to which the broad and shallow but sweetly-modeled river boats lend themselves admirably. The largest vessels for the night service are of over 4,000 tons displacement, and are driven by engines of 4,000 horse-power; yet they draw only about 8 feet of water. It would be a difficult proposition to drive such vessels with screw propellers. Furthermore, the large number of landings which must be made call for a boat with good maneuvering qualities, able to stop and start quickly, and make quick landings at the piers. The paddle-wheel beam-engine boat has proved to be ideal for this purpose. While it is well

understood by the engine builders and shipping men of the Hudson River that high boiler pressures, multi-cylinder expansion, and rapidly-running engines are conducive to fuel economy, it is also realized that these economies can be secured only when the engines are continuously in service. Otherwise, the heavy extra capital cost of the more expensive installation is liable to exceed the saving due to coal economy. The Hudson River boats are out of service for about five months of the year; and although a multi-cylinder engine will run under a consumption of from 1.5 to 1.75 pounds of coal per horse-power per hour as against 2.3 pounds for a low-pressure single-cylinder beam engine, the greater first cost of the plant will go far to offset the saving in the coal bill. The cost of upkeep, moreover, of the beam engine is relatively far less. The boilers, built for 50 to 55 pounds pressure, generally carry from 30 to 35 pounds under an easy fire. This means a lessening of boiler repairs, since it is easier on steam pipes, joints, and packings. Moreover, the engine-room force is reduced to a minimum, an engineer and an oiler generally being sufficient to take care of the average Hudson River engine.

The accompanying illustrations of the 3,800-horse-power engines of the "Adirondack" of the night line, the last of the large river steamers to be built of wood, will serve admirably as a reference in connection with the foregoing description of the typical river-boat engine. The "Adirondack,"



Cylinder, 81-inch diameter by 12-foot stroke. Horse-power, 3,800. Boiler pressure, 55 pounds. The two vertical pipes in front of the cylinder are the "side pipes," one the steam pipe, the other the exhaust. They communicate with transverse steam chests at top and bottom in which are the poppet valves. The latter are operated by two vertical rods, which are lifted by cams on rock shafts, driven by the eccentrics.

## ENGINE OF THE "ADIRONDACK."

stroke. The "Constellation," 1825, used a cylinder 44 inches in diameter by 10 feet stroke, and these remained about the maximum dimensions until the appearance of the "South America," 1840, with cylinders 54 inches in diameter by 11 feet stroke. The keen contest for speed resulted in the construction of engines that were prodigious for those days, and have barely been exceeded at the present time. Thus in 1845 there was built for the "Hendrick Hudson," which was a fine vessel 320 feet long, an engine with a 72-inch cylinder and 11 feet stroke; and two years later T. F. Secor & Co. built for the "New World," one of the fliers of that day, an engine with a 76-inch cylinder and the enormous stroke of 15 feet. Thereafter the stroke was reduced to 12 feet, which was never again exceeded. The largest engine afloat on the Hudson is that of the "C. W. Morse," of 4,000 horse-power, built in 1904 by the W. & A. Fletcher Company, whose cylinder is 82 inches in diameter by 12 feet stroke.

The permanence of the walking-beam engine as the

which is 412 feet long, 50 feet beam, and 90 feet over the guards, with four decks above the waterline, and over 400 separate berths for the passengers and crew, was built in 1896. The vessel serves to show the point of size to which these stately river boats have been developed. In the engraving the side of the hull and superstructure has been broken away to show the full height of the engine, which was built by the W. & A. Fletcher Company. The engine foundation consists of heavy steel keelsons. The A-shaped galloway frames are built up of steel plates, the legs, which are of box section, being strongly braced together with struts, which are also of plate steel and box section. The walking beam consists of a strongly-ribbed cast-iron web, belted with a heavy wrought-iron strap; the whole being firmly strapped and keyed together. The cylinder is 81 inches in diameter by 12 feet stroke. The two large vertical pipes seen in front of the cylinder are known as the side pipes; the one on the star-

(Continued on page 229.)

### THREE HUNDRED YEARS OF NEW YORK.

When Henry Hudson approached the opening of the upper bay he did not at first know that he was near-

we present herewith. This is the earliest known view of New York, and the little book in which it was published is of the greatest rarity. To obtain a correct idea of the topography, it is necessary to view the plan in a mirror, as it is reversed. It was probably obtained with the aid of a camera obscura from some point on the Long Island shore and was never restored to its proper position.

There does not appear to have been any attempt to found a substantial colony until 1621, when the Dutch West India Company came into existence. It was admirably organized and they established a strongly garrisoned colony which was the nucleus of a colonial government which was in control of a vast territory which stretched from Virginia to New England. The municipality itself, however, was of almost micro-



EARLIEST KNOWN PRINT OF NEW YORK CITY ENTITLED: "FORT NIEUW AMSTERDAM OP DE MANHATANS," PUBLISHED IN 1651.—  
POPULATION ABOUT 300.

ing the river which was afterward to bear his name. He believed that it was an arm of the sea, in fact, that it was the northwest passage to India, that *Ignis Fatuus* of so many of the old navigators. He lay in the lower bay for more than a week before he anchored in New York Harbor proper. He found the neighborhood well peopled by Indians who lived in villages of fairly regular construction. They were mild and inoffensive, as savages go, and they were quite willing to trade their tobacco and pelts for the beads and knives of the white men.

Hudson at last discovered that he was at the estuary of a great river, up which he sailed, consuming three weeks, until he reached the head of navigation at Albany. Early in October, Hudson turned the prow of the "Half Moon" homeward, bringing the news of a discovery which was of the greatest possible interest among the Dutch merchants. A number of trading and exploring expeditions started out and made the trip with considerable profit to themselves.

It was at last decided to establish permanent posts at the head of the river and at New York. The main fort was built near the mouth of the Mohawk River, and a few trading huts were built at the south end of Manhattan Island, and it is from this small beginning that we are enabled to trace the industrial beginning of the city of New York.

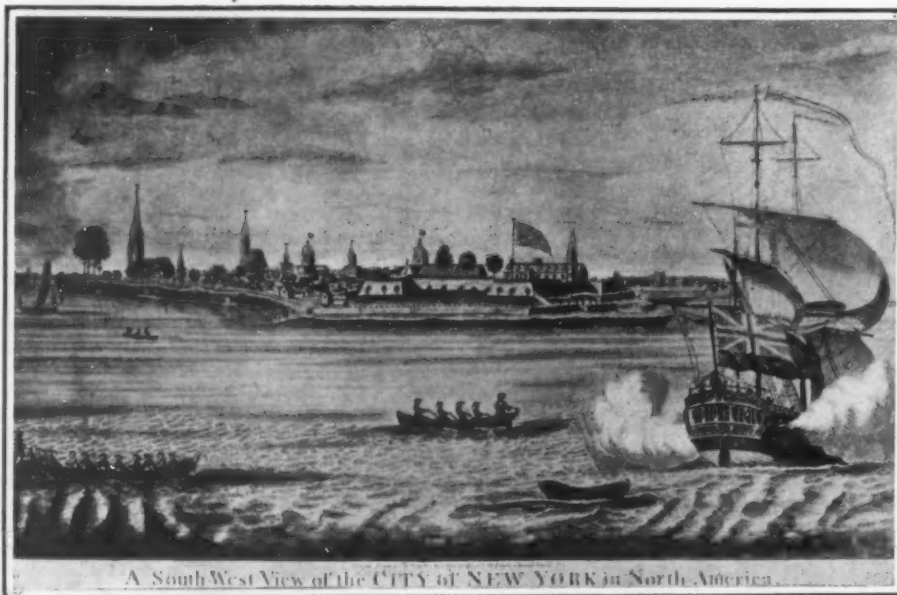
A monopoly of the fur trade was given to the New Netherlands Company, which erected a trading post at New York. The monopoly, which was a valuable one, was extended from year to year, until 1621, when the Great West India Company was chartered. It was under its auspices that the first real and permanent settlement in New York was made.

The city of New York has been very fortunate in the preservation of the early records of its settlement. The early history of Rome, London, and even Paris, is lost in obscurity, while other cities, such as Berlin and St. Petersburg, have no history of any importance, and still look painfully new and as though they were planned with the aid of the T-square and drawing pen. From these records we learn that the original block house with its palisades gave way to Fort Amsterdam, around which clustered the small cabins of the first settlers. Some idea of the early appearance of the settlement is obtained from a view in Hartgers' "Beschrijvinghe van Virginia," a copy of which

Although the print is on a small scale, it gives considerable detail, the number of buildings shown being about thirty or thirty-five. In the fort were situated the Governor's house, the chapel, barracks for the soldiers, magazines, and other necessary buildings.

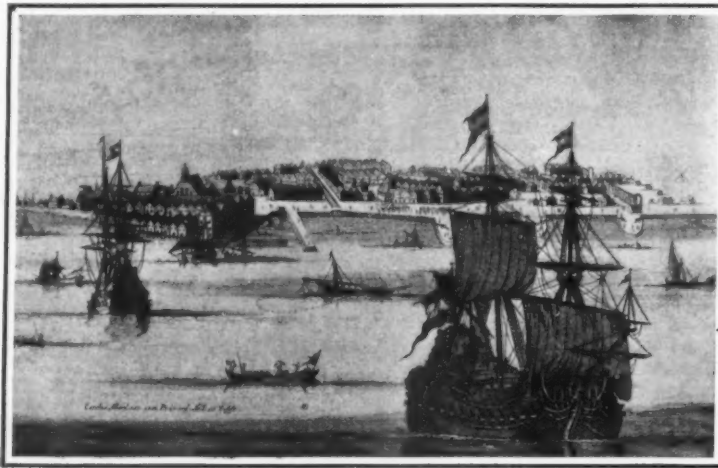


MAP SHOWING INCREASE OF CITY AREA ALONG THE WATER FRONT OF LOWER NEW YORK. THE ORIGINAL CITY IS SHADED.



NEW YORK UNDER BRITISH DOMINION JUST BEFORE THE REVOLUTION.

Among the landmarks are Trinity Church, the old Dutch Church, and Fort George. The population in 1771 was 21,863.



NEW YORK IN 1673.

Buildings have been erected within the fortified enclosure; streets have been laid out leading to wharves. The population in 1664 had grown to 1,500 and in 1696 it was 4,937.

scopic proportions, for in 1628 we find that the inhabitants numbered only 270, but the fort was constantly increased in strength until it became a fortress of no mean magnitude for the size of the place. In 1626, Peter Minuit purchased the whole of Manhattan Island for trinkets, the aggregate value of which was \$24. It would perhaps be interesting to figure up how much the interest at 6 per cent, compounded at regular intervals, would be on the \$24 for the period since the purchase.

In 1653, when a foray of New Englanders was expected, a stockade or palisade was erected across the island from east to west, thus fortifying the outskirts of the inclosure. This was at the point where we now have a teeming center of finance—Wall Street. Strange to say, this wall prevented the natural expansion of the city for over half a century and always tended to create that congestion which still remains so overwhelmingly strong. Every old and important city in Europe has been cramped within a stone girdle of fortifications, and long after the necessity for this has vanished the habit of congestion remains.

The present crowded tangle of streets at the southern termination of Manhattan Island is entirely attributable to the customs of the Dutch dwellers. There was little attempt made to lay out broad or convenient streets. The foot-paths and lanes became the future streets, and no better example can be adduced than this, that the early pre-arrangement of the south never obtained in northern lands. One of the earliest streets was nearly parallel with the present Pearl Street and the other with Broadway, while "Dock" Street led to the shipping quays.

After a long and rather interesting occupancy by the Dutch, the flag of Great Britain was raised on September 8, 1664, and Fort Amsterdam forthwith became Fort James. There was little or no dislike of the conquerors, who made a peaceful invasion without striking a blow. England's policy was not so liberal in those days as in her present handling of colonial matters. Still, however, the Dutch hardly knew that the form of government was being changed, so that now the isolated trading post became a national colonial dependency. Under the old régime there was no home pride among the commercial owners, but the new conditions put a different aspect on the situation, and



SEPTEMBER 25, 1909.

was opened in 1808. A number of scientific and literary societies were founded in New York at the beginning of the nineteenth century.

Before the days of the steamship and the railroad, was the era of the fast "clipper," like those which ran from Baltimore and which were famous for their great size and speed. So fast were they that for many years after steamers were built they maintained a nearly equal flight against their more formidable rivals. Fast vessels made the trip to England in fourteen days. It seems extraordinary that the United States, that during the first half of the nineteenth century brought the art of shipbuilding to such a high plane, should be so neglectful of her ocean commerce in the last half of the century. The more recent events

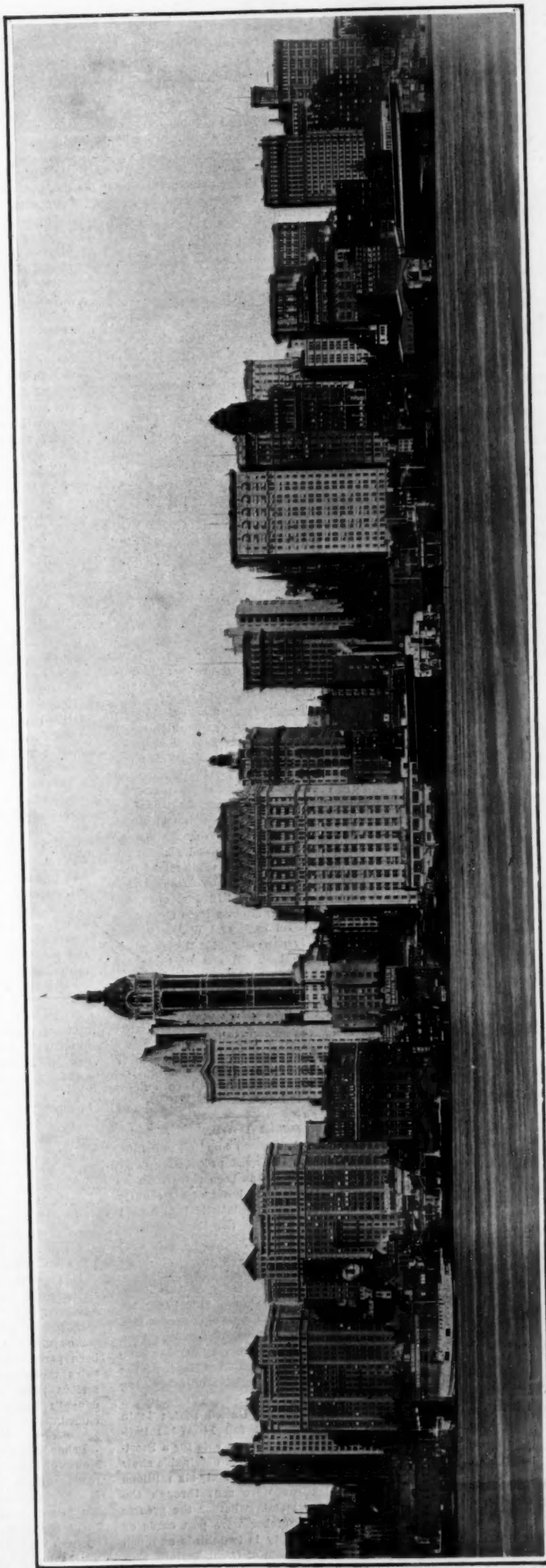
thought that a space should be set aside sufficient for a reservoir. They also felt the need for a space for military exercises, so that the "Parade Ground," which extended from Twenty-third to Thirty-fourth Streets, and from Fourth to Seventh Avenues, was provided. We have the remains of the "Parade Ground" in Madison Square, and the whole space includes some of the choicest business locations in the entire city. Union Square was a union of the many roads which centered at that point for the transfer of traffic, and may be regarded as a "geographical accident." They provided streets which reached as far as 155th Street northward, reaching from the Hudson to the East and Harlem Rivers. The plan of New York, as we find it to-day, is stupidly commonplace, and it has cost

ments, the results would have been far different. They were allowed four years in which to prepare their plans and fix posts at suitable points. In 1811, they made their reports and their maps were filed, which created the city from Houston Street to Washington Heights substantially as it exists to-day. Without doubt their labors were most arduous, as a survey involving the placing of "1,549 marble monumental stones and 98 iron bolts" proves. The commissioners had the opportunity to create a most beautiful city instead of the commonplace utilitarian arrangement from which the citizens are now suffering. These worthy men left undone the things which they should have done, and did the things which they should not have done. They decided that the beautiful forest growths should be

the inhabitants began to grow fond of their new surroundings and government.

In 1783, when New York was evacuated by the British troops, the condition of the city was most deplorable. The streets, which had been paved and partly graded before the war had been suffered to lapse into idle wastes again. The wharves had rotted, and all the public and many of the private buildings had fallen into a state of semi-ruin. The population had decreased and the city was practically wrecked. Under the inspiration of the new government the inhabitants revived the city within three years, so that the former population was regained and commerce quickly returned.

We have before noted the crookedness of the streets in



Copyright, 1908, by George P. Hall.

the lower part of the city, especially below the stockade at Wall Street. At the beginning of the nineteenth century nearly all of Manhattan Island, down as far as Fourteenth Street, was practically a virgin territory which could be treated in any way which seemed conducive to the public good. It was thought to be wise to make a plan which would be so comprehensive that the growth of the city would be provided for for a couple of centuries or more, so that an act of the Assembly was passed on April 18, 1807, and a commission of well-intentioned but blundering men was appointed—men who were of great importance for the time—as "Commissioners of Streets and Roads in the City of New York." They were given much power, and had they not been so mediocre in their attain-

THREE HUNDRED YEARS LATER—THE SKYLINE OF THE HUDSON RIVER SHORE FROM CITY HALL TO THE BATTERY WITH THE SINGER BUILDING OUTSTRIPPING ALL IN HEIGHT.

millions to give even a semblance of variety to the work of these worthy gentlemen. Among the mistakes which the commissioners made was to provide one-third less to the square mile for longitudinal streets than they did for cross streets. They did not seem to realize that they were dealing with a long and narrow island whereon the traffic would always be in a longitudinal direction, but we are now feeling the stern necessity for increased facilities for north and south travel.

In 1805, the free school system was founded. Prior to that time schooling was largely a matter of private enterprise. Each church had its own school and there were also numerous private schools kept by teachers who were remunerated for their services. The first public school

connected with New York city are outlined in the chronology which follows, and which has been especially compiled for this issue:

When we look at the impressive picture of the sky line from the City Hall to the Battery there is one point which is of surpassing interest—how was it possible to secure enough ground to permit of the erection of such vast structures?—as we know that the original territory comprised in this part of Manhattan Island in the days of Peter Minuit was not so great. When Manhattan Island was first purchased from the Indians, there was doubtless little thought that it would ever be necessary to increase the area of the seemingly large island. From the beginning, however, we find examples of made land, of docks being





# DEVELOPMENT OF THE HUDSON RIVER STEAMBOAT.

(Concluded from page 217.)

the development of the river steamboat had been carried at that early date. Both boats had return-flue iron boilers, and when pushed to their highest speed would burn from twenty-three to twenty-five cords of wood per trip. The rivalry between the two became so great that finally a formal race from New York to Albany was decided upon, and on November 8th, 1836, they started abreast of each other at 4 P. M. with everything tuned to the highest pitch. The "Rochester" reached Van Wles Point, 140 miles from New York, in eight hours and fifty-seven minutes, and the "Swallow" five minutes later. Some interesting details are given by David Stevenson in an English work, "Engineering in North America," published in 1838, of a trip which he made on the "Rochester" in 1837, when the distance to Albany was made in ten hours and forty minutes. The steam pressure, according to this authority, was 45 pounds, and the steam was cut off at half stroke. Speaking of the remarkable speed of American steamboats at this time, he says the vessels "navigating the Hudson River and Long Island Sound perform their voyages safely and regularly at a speed which far surpasses that of any European steamer hitherto built." A good description was given during this period by a German visitor of a trip made in 1838 on the "North America." He gives the length of the vessel as 200 feet, her beam as 26 feet, and describes her as having two decks, the lower of which was about three feet above the water. There were separate cabins for men and women, that for the men being used also as the dining room. He writes: "There were 320 passengers on board, each of whom slept in a berth, and as sufficient room appeared still to remain, one may imagine how colossal this floating palace must be." He paid three dollars, or two cents per mile, for the passage. In "less elegant" steamboats the fare was one dollar, and in some boats as low as fifty cents.

The inventive and original mind of Robert L. Stevens was shown in the design of the "Rainbow," an experimental vessel of very narrow beam, the breadth of which compared to her length was as 1 to 14. She was driven by a pair of inclined condensing engines, one forward and one aft of the wheel, with cylinders 36 inches by 10 feet, coupled to a common crankpin. Her boilers, strapped at every 10 inches with bar iron, 1 1/4 by 6 inches, carried the enormous pressure for those days of 80 to 100 pounds per square inch. The hollow wheel shaft, made of 3/4-inch boiler iron, was 3 feet in diameter. She did not make the high speed expected, and was subsequently used for towing.

The contests of speed which characterized that period were accompanied by rate wars, in which passengers were carried over the full course at rates which at one time dropped as low as twelve cents; and it is recorded that on one occasion rather than see an opposition boat carrying a full passenger list, a rival steamboat offered twelve cents apiece to the public for the privilege of taking them; the deficit being subsequently made up when the ship was under way by the simple expedient of raising the price of meals by 300 per cent.

As evidence of the high state of development to which the steamboat had been carried by the middle of the century, we quote the case of that handsome steamer "Alida," built in 1847 by William Brown of New York. This craft, of which we present an excellent illustration, was 265 feet long, 30 feet broad, and 7 feet deep. She was driven by a steam engine with cylinders 56 inches diameter by 12 feet stroke. From the very first she proved to be a "flyer"; and on May 8th she made the trip of 145 miles from Albany to New York, with six landings, in seven hours and fifty-six minutes. She

**"Star" Lathes**  
Automatic Cross Feed  
FOR FINE, ACCURATE WORK  
Send for Catalogue B.  
SENECA FALLS MFG. CO.  
695 Water Street,  
Seneca Falls, N. Y., U. S. A.

**Engine and Foot Lathes**  
MACHINE SHOP OUTFITS, TOOLS AND SUPPLIES. BEST MATERIALS. BEST WORKMANSHIP. CATALOGUE FREE.  
SEBASTIAN LATHE CO., 120 Culvert St., Cincinnati, O.

**Incorporate** Your PATENTS and BUSINESS in ARIZONA  
Laws the most liberal. Expense the least. Hold meetings, transact business anywhere. Blanks, By-Laws and forms for making stock full-paid for cash, property or services, free. President Stoddard, FORMER SECRETARY OF ARIZONA, resident agent for many thousand companies. References Any bank in Arizona  
**STODDARD INCORPORATING COMPANY, Box 8000 PHOENIX, ARIZONA**

**FLY PAPERS.—FORMULAS FOR**  
Sticky Fly Papers are contained in SCIENTIFIC AMERICAN SUPPLEMENT Nos. 1057 and 1324. Each issue contains several recipes. Price 10 cents each, from this office, and from all newdealers.

**THIS GRINDER**  
Has no pumps, no valves. No piping required to supply it with water. Always ready for use. Simplest in construction, most efficient in operation. Price sold delivered here  
W. F. & JNO. BARNES CO.,  
Established 1875.  
1909 Ruby St., Rockford, Ill.

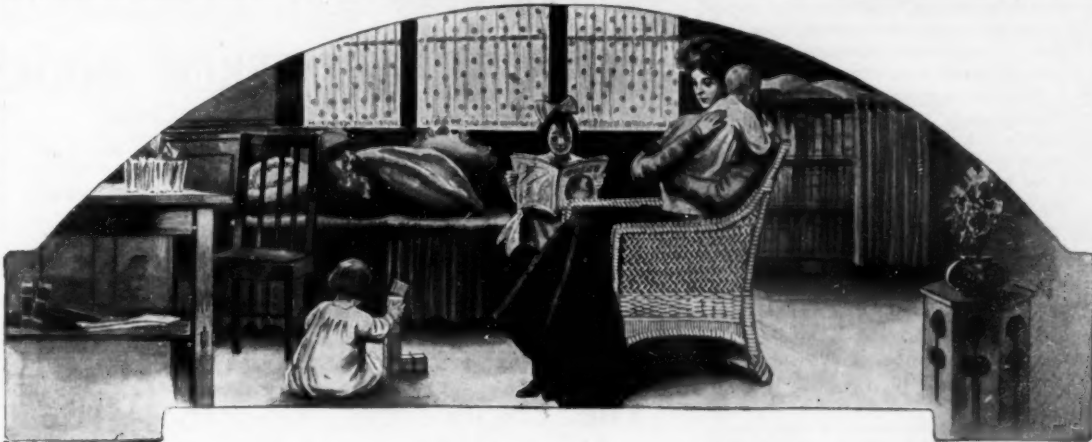
**Veeder Counters**  
to register reciprocating movements or revolutions. Cut full size. Booklet Free.  
VEEDER MFG. CO.  
18 Sargent St., Hartford, Conn.  
Cyclometers, Odometers, Tachometers, Counters and Fine Castings.  
Represented in Great Britain by Messrs. Massey & Co., Ltd., 9 City Road, Finsbury Square, London, E. C., England.

**THE BEST EQUIPPED SHOP**  
For Mechanical and Electrical Manufacturing  
**Special Machinery, Jigs, Tools, Repairs, Experimental Devices**  
Designing and Commercializing a Specialty  
THE ROWLAND TELEGRAPHIC COMPANY Baltimore, Md.

**BELLE ISLE Marine Engine**  
2 to 3 H. P. Bare Engine \$23  
Swiftest, most powerful, efficient and reliable 3-Cycle engine of its size on earth—entirely new design, improved and perfected in every detail—makes speedy little launch from an ordinary row-boat. Catalogue describing all sizes FREE.  
New Belle Isle Motor Co., Dept. H, Detroit, Mich.

**"AERONAUTICS"**  
How to Build a Flying Machine. Read the descriptions of successful machines. The news of the world told accurately, geographically and pictorially. Practical articles and construction data. The only Aero Journal in America—the largest and best Aero magazine in the world. Third year. Send 10 cents for sample copy.  
"AERONAUTICS," 1775 Broadway, New York

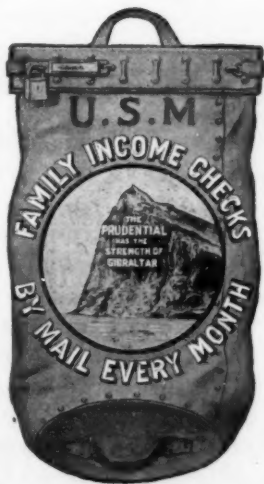
**Mason's New Patent Whip Hoists**  
FOR OUTRIGGER AND INSIDE HOISTING  
Faster than elevators; also hoist direct from teams, saving handling; also electric and power elevators, carriage and hand power elevators. Mason's patent friction pulleys and friction clutch couplings. Manufactured by  
**VOLNEY W. MASON & COMPANY, Inc.**  
Providence, R. I., U. S. A.



Leave Your Wife a Fixed Monthly Income for Life

# The Prudential

Newest Monthly Income Policy



Provides a Cash Payment at death of Insured AND THEN a regular MONTHLY INCOME for your wife for 20 years or for life

**COST IS LOW**

**\$1230 cash, and \$50 a month for Life**

COSTS

If Age of Insured is 30, and Age of Beneficiary, 25

**\$221.40 per Year**

An Average Saving of \$18.45 per month, NOW

The Income can be arranged for in Multiples of \$10 per month up

**The Prudential Insurance Company of America**

Incorporated as a Stock Company by the State of New Jersey

JOHN F. DRYDEN, President

Home Office, Newark, N. J.

Without committing myself to any action, I shall be glad to receive free particulars and rates of AN IMMEDIATE BENEFIT AND CONTINUOUS Monthly Income Policy.

For \$..... a month  
With Cash Payment at Death.....

Name.....

Address.....

Beneficiary's Age.....

My Age is..... Dept. 121

was not, however, the first boat to bring the time below eight hours, that distinction belonging to the "South America," which on April 19th, 1843, covered the distance in the extraordinary time of seven hours and twenty-six minutes. This trip, however, was made without any landings, and the vessel was favored by a heavy freshet in the river, which not only gave deep water over the shoals, but set up a swift current in the vessel's favor.

It is impossible, within the limits of the present article, to follow in detail the development of the famous steamboats on this famous river. There was a steady increase in size, though the speed, having been carried to the high point of between twenty-one and twenty-two miles an hour, was destined to remain stationary. We can do no more than mention two celebrated boats, the "New World," of the People's Line, with wheels 45 feet in diameter and a piston of 15 feet stroke, and the "Francis Skiddy," with 40-foot wheels and a 14-foot stroke of piston, two vessels which had many struggles for supremacy during the ensuing decade.

We pass on to the year 1852, when in consequence of the many deplorable accidents which occurred, due to the too frequent bursting of boilers, Congress passed a law for the inspection of vessels, which put an end to the perilous practice of steamboat racing. The stories which have come down to us of the reckless way in which engineers would "bottle up their boilers" when racing with a rival boat are astonishing, but nevertheless well verified. Morrison, a most careful historian, credits the statement of an engineer that, on being pressed by his captain to pass another boat, he "prepared for the contest by tying the safety-valve lever, drawing the pointer from the mercury gage, plugging up the mouth of the tube, and urging the fires under the boilers." He passed the other boat, but we are not surprised to learn that it was his opinion that although ordinarily he carried thirty pounds, the pressure during the contest must have risen to fifty or sixty pounds to the inch.

It is probable that the Hudson River boat which has attained the most world-wide popularity is the "Mary Powell," of the Day Line, which, built in 1861, has been in continuous service ever since, and is to-day one of the most popular boats on the river. Her original dimensions were 260 feet length, 34½ feet beam, and 10¼ feet depth. Her model is particularly sweet, with a long, sharp entrance and a very easy run. Her fastest run was made from New York to Poughkeepsie, 73½ miles, in three hours and thirty-nine minutes, including the time lost in six landings. Deducting this time, her average speed, while running under full power, was 22.54 miles per hour. Her present captain, A. E. Anderson, a son of her previous owner and captain, informs us that during her long life of nearly half a century she has been rebuilt three times and lengthened 40 feet. The lines of the original boat, however, have been religiously preserved. Her present length is 300 feet. Her original engines had one cylinder, 62 inches by 12 feet, which was replaced by a cylinder 72 inches by 12 feet stroke in 1874. Steam is supplied by two return-flue tubular boilers, and she uses a working pressure of thirty-five pounds, under which she makes the eighteen miles per hour necessary to make her scheduled time. Under the forty-five pounds which she is allowed, this wonderful old craft is still good for twenty miles an hour. The hull of the "Mary Powell" was built by M. S. Allison of Jersey City, and her present machinery by the W. & A. Fletcher Company of Hoboken.

Another wooden vessel famous in her day was the "St. John," 1864, the cylinder of whose engine was 85 inches in diameter with the exaggerated stroke of 15 feet.

The year 1880 was signalized by the appearance of the first iron steamboat,

The Most Useful Adding Machine  
is the one that adds, multiplies, divides and subtracts—with unlimited speed—and the ONLY such machine is the

**Comptometer**  
ADD'S MULTIPLIES DIVIDES SUBTRACTS  
In A Class By Itself

Isn't it plain that it necessarily must pay you larger dividends because of its complete range of usefulness and speed? Other machines simply add—one-fourth as useful—and then only half as fast. The Comptometer easily earns its price three to five times each year. That is why we want you to try the Comptometer.



Marshall Field & Co., Chicago, 406.  
Western Elec. Co., N. Y., Chicago and branches, 106.  
Chicago, Burlington & Quincy Ry. Co., 106.  
T. Eaton & Co., Toronto and Winnipeg, 41, and thousands

of others use Comptometers for their figuring, because there is no other adding or calculating machine as rapid or durable.

"It is no exaggeration to say the Comptometer enables one man to do the work of two. We find the work absolutely correct when it is done with the Comptometer. Would not be without it for double the price." C. V. THOMPSON, Columbia County Auditor, Dayton, Wash.

Write for book, free. Let us send a Comptometer on free trial, express paid, U. S. or Canada? Felt & Tarrant Mfg. Co., 851 No. Paulina St., Chicago, Ill.

## VALUABLE ENGINEERING BOOKS

All Books Listed at NET Retail Price

- CIVIL SERVICE:** Manual of Examinations by Lewis & Kempner. Send for descriptive circular of separate Parts and Volumes.
- SURVEYING MANUAL:** Pence and Ketchum. The Standard College Field and Text Book. Flex. leather 4½ x 6½ inches; 250 pages; illustrated. . . . . \$2.00
- TECHNIC OF MECHANICAL DRAWING:** C. W. Reinhardt. Cloth; oblong; 8 x 11 inches; 42 pages; 90 illustrations; 11 full page plates. . . . . 1.00
- ELEMENTARY ALGEBRA:** Manual of examinations in Mathematics. L. H. Lubarsky. Cloth; 6 x 9 inches; 288 pages. . . . . 1.50
- RAILWAY TRACK AND TRACK WORK:** E. E. R. Traiman. Cloth; 6 x 9 inches; 520 pages; 232 illustrations; 44 tables. . . . . 3.50

We can supply books on all Technical subjects.

The Engineering News Book Dept.  
220 BROADWAY, NEW YORK

## The Outdoor America Numbers of Collier's

The National Weekly

These Outdoor America Numbers are edited by Caspar Whitney. There is one of them each month, carrying six or eight pages of text and pictures devoted to all kinds of activity in the open air—hunting, fishing, motoring, athletics, gardening, fruit-growing, chicken-raising, and a score of kindred subjects.

The number dated October 16 and appearing on the news-stands at that time is to be a particularly good one, with unusually fine photographs. There is an automobile article by Albert Lee, a story about "The Poor Man's Race Horse"—whippet hounds; an article on how to find and track deer, another concerning the use of electricity for light machinery on the farm, and still another—of rare interest—on athletics at the Vatican, with some splendid photographs.



Collier's  
The National Weekly

the "Albany," the second being the "New York," 1886. These, with two exceptions, are probably the fastest large passenger steamers plying on American inland waters to-day. With their long, unbroken lines, graceful sheer, and triple buff-colored smokestacks, they present as beautiful a marine picture as one would wish to see. Both vessels, after being some time in service, were lengthened by the addition of 30 feet, and as thus altered their dimensions are: "Albany," 325 feet length by 40 feet beam; and "New York," 341 feet length by 40 feet beam; the breadth of both vessels over the guards being 76 feet. The engines are of the typical walking-beam type, with cylinders 76 inches diameter by 12 feet stroke. They were allowed fifty pounds pressure, but thirty-five pounds is sufficient to enable them to attain their scheduled speed of about eighteen miles an hour. The "Albany" holds the blue ribbon of the Hudson River. On October 22nd, on her way up to Albany for winter quarters, she was given an engineer's trial for speed. Leaving 22nd Street at 11:01 A. M., she reached Poughkeepsie dock at 2:09 P. M., thus covering 72½ miles in three hours and eight minutes, at a speed of 23.26 miles per hour. On May 28th, 1903, the sister boat, the "New York," made the same trip at an average speed of 23.21 miles per hour.

In 1906 the Hudson River Day Line placed in service the handsome steel passenger steamer "Hendrick Hudson," which measures 390 feet over all, 43 feet breadth of hull, 82 feet over the guards, and draws from 7½ to 8 feet of water. The vessel was designed by F. E. Kirby of Detroit and J. W. Millard of New York, who were subsequently engaged by the Hudson-Fulton Commission to design the replica of the "Clermont." Including that in the hold, the vessel has six decks, four of which are available for passenger accommodation. These decks are unusually spacious, and they can accommodate, without crowding, five thousand passengers. The dining room has accommodations for 262 persons. The vessel is driven by an inclined, double-expansion paddle-wheel engine, with a 45-inch high-pressure and two 70-inch low-pressure cylinders acting on three cranks, the common stroke being 7 feet. Steam is furnished at 170 pounds pressure by eight boilers. The paddle wheels in this vessel, as in the "New York" and "Albany," are of feathering type. On her trial trip, made over the measured course on the Hudson, she made 24.5 miles per hour, or about one mile an hour more than the high speed credited to the "New York" and "Albany." The latest addition to the Day Line boats is the "Robert Fulton," built to replace the "New York," which was burned while in her winter quarters. The "Robert Fulton" is 348 feet in length, 42 feet beam, and 76 feet in width over the guards. She was built by the New York Shipbuilding Company of Camden, N. J., and was launched in the record time of two months and ten days after the keel was laid. The hull, which is built of steel, is considered by the company to possess the finest model of any of the large steel vessels of the Day Line. She embodies the best features of the model of the "Mary Powell" and other fast boats, and her appearance on the year of the centennial anniversary of Fulton's great work is very timely. Her maximum speed is 23½ miles an hour. Our illustrations include one of the "Adirondack," which may be taken as typical of the fine fleet of steamers owned by the People's Line, which makes the night trip between New York and Albany. These boats differ from the Day Line steamers in their larger size, more moderate speed, and the towering superstructure for the accommodation of the many tiers of staterooms. The "Adirondack" is 412 feet in length, 50 feet in beam, and draws 8 feet of water. Being a wooden vessel, she is strengthened by the two big suspension trusses which are such a characteristic of the American river steamer. She has 350 staterooms. Her engines, of



3,800 maximum horse-power, can drive her at a speed of 20 1/2 miles an hour. The maximum in size and accommodations is reached in the "C. W. Morse," of the People's Line, which is 427 feet over all, 90 feet over the guards, and contains 450 staterooms. The dining room will accommodate at one time 300 people. She is driven by a walking-beam engine with a cylinder 81 inches in diameter by 12 feet stroke, and her maximum speed is 20 1/2 miles per hour.

In the above necessarily brief story of the development of the Hudson River steamboat, we have endeavored to bring out the salient points of the increase in size, speed, and accommodation of one of the most remarkable and successful types of vessel in the world to-day. It would be well in closing to refer to the phenomenal speeds which were achieved by these vessels over half a century ago, and draw attention to the fact that their record passages were usually made when wind and tide were favorable. The swiftest of the present-day boats would undoubtedly exceed the earlier speeds, though by no very great margin; and it must be remembered that, under existing conditions, they are run under a fixed schedule, generally under a reduced steam pressure, and are operated at several miles less speed than the maximum of which they are capable.

#### THE AMERICAN WALKING-BEAM ENGINE.

(Concluded from page 223.)

board side being the steam pipe, and the other the exhaust. Each of these pipes carries a separate rocking shaft, which is operated by its own eccentric. The motion of each rocking shaft is communicated to two vertical lifting rods, which operate the valves by means of two cams called "wipers." The eccentric rods are formed with hooks at their outer ends, which engage a pin in the arms of the rocking shafts. They are thrown out of gear by means of the slotted vertical rods through which the eccentric rods work, one of which will be seen in the engraving. These vertical rods are known as strippers, and they are operated by the levers which will be noticed attached to the rocking shaft on the steam pipe. When it is desired to start or reverse the engine, the eccentrics are thrown out of gear, and the valves are worked by a steam starting and reversing engine, which is controlled by the vertical lever seen near the steam pipe. If it is desired, the valves can be operated by the vertical starting bar shown in the engraving.

The handwheel on the small vertical standard in front of the exhaust pipe opens the steam valve for the starting engine, and the wheels which are seen on the other two standards are for operating the injection valve and for turning the surface condenser into a jet condenser, if at any time it should be desired to do so. The surface condenser is located in front of the steam cylinder and below the main deck. Behind the steam cylinder and also below the main deck is the air pump, which is operated by connecting rods from the walking beam. The gear shown attached to the front face of the gallow's frame, above the cylinder, is a hand winch, for lifting the cylinder head.

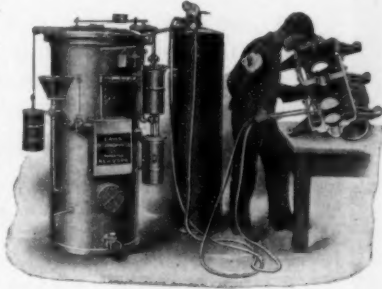
The paddle wheels are of what is known as the vertical or feathering type, in which the buckets are made to enter and leave the water in a nearly perpendicular position. The old type, with fixed radial buckets, is extravagant and uncomfortable; extravagant because it wastes power in forcing water downward when the buckets strike, and lifting it when they leave the water; and uncomfortable because it sets up a violent vibration throughout the whole vessel. The feathering paddle wheel is smoother and more efficient in its action, and its efficiency is from 12 to 15 per cent greater than the older type. Its construction is as follows: Bolted to heavy timbers just above the guards is a large

#### "A PUTTING ON TOOL"

### The DAVIS-BOURNONVILLE PROCESS of Oxy-Acetylene Cutting and Welding Is the Greatest Invention of the Decade

#### Progressive Metal Workers

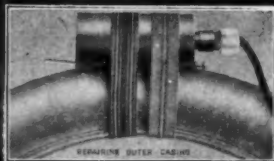
Are adopting it rapidly. Our Plants are now being used to great advantage by manufacturers of metal furniture, sash and doors, steel cars, iron and steel pipe, seamless boilers and tanks, electrical apparatus, automobiles, and by iron, steel and brass foundries, for reclaiming castings and very extensively by repair shops for mending broken machinery, engine cylinders and aluminum automobile casings and for building up worn gears and other parts. Our Cutting Torch is invaluable for cutting steel piling and structural iron, and for wrecking steel and iron work.



#### FIVE PLANTS IN USE BY UNITED STATES NAVY

For complete information address

**Davis-Bournonville Company**  
84 West Street, New York, N. Y., U. S. A.



If You Have an Automobile or Motorcycle  
YOU NEED A  
**Buffalo Electric Vulcanizer**  
It is simple and attaches to any electric light socket, is automatically controlled and will not injure the tire. You can do your own repairing and Save Time—Save Money—Save Patience.  
Write to day for our booklet—"Tire Troubles." It's free.  
BUFFALO ELECTRIC VULCANIZER CO., 122 Erie County Bank Bldg., BUFFALO, N. Y.

## Business Openings In New Towns

A small store, hotel or other business established Now in one of the new towns on the new line to the Pacific Coast will, in a few years, prove a big money-producer.

Dozens of business openings are offered To-day in the growing new Dakota, Montana, Idaho and Washington towns on the

## Chicago Milwaukee & Puget Sound Railway

If you are thinking of engaging in some mercantile or professional line, why not locate in one of these new towns?

"New Towns and Business Opportunities" is the title of a book describing the new towns along this new line and along the Chicago, Milwaukee & St. Paul Railway. It may be had for the asking. Send for it to-day.

F. A. MILLER  
General Passenger Agent  
Chicago, Milwaukee & St. Paul Ry.  
CHICAGO

GEO. A. BLAIR  
General Eastern Agent  
Chicago, Milwaukee & St. Paul Ry.  
381 Broadway, N. Y. City

pin carrying a loose flanged ring, to which are pivotally attached a set of connecting rods. At their outer ends these rods are pivotally connected to rocking arms fastened to the back of the buckets, the buckets themselves being pivotally attached to the rigid spokes of the paddle wheel. The pin and loose ring are placed eccentrically to the crankshaft, and the ring is rotated in its proper relation to the paddle wheel by attaching one of the connecting rods rigidly to it. The eccentricity of the ring is so adjusted that the buckets shall always enter and leave the water in a perpendicular position, thus securing a true feathering action. The wheels are 30 feet in diameter.

Steam is supplied by four steam boilers, of the lobster-tail return flue type, each 11 feet wide, 9 feet 3 inches diameter of shell, and 33 feet long, with steam domes 87 inches diameter and 10 feet 6 inches high. Forced draft is supplied by two large Dimpfel blowers, driven by independent engines. The steam pressure is 55 pounds to the square inch, and the total horse-power is 3,800.

#### RECENTLY PATENTED INVENTIONS. Pertaining to Apparel.

ADJUSTABLE PATTERN.—M. ROGUSHEFSKY, New York, N. Y. This invention consists in the construction and combination of parts, whereby the different edges of the pattern may be moved outwardly or inwardly substantially in parallelism, without varying the relative proportions or the general shape of the pattern. Attachments are employed for varying the style of the garment, rendering one pattern useful for cutting different forms of garments.

PNEUMATIC HEEL-CUSHION.—W. L. GORDON, Deal, N. J. The cushion is such as worn at the heel of the shoe on the inside in order to cushion the heel in walking. The cushion has an improved form which increases its elasticity in action, and a further object is to provide improved means for holding the cushion in position.

#### Electrical Devices.

TELPHER SYSTEM.—B. T. HIRSH, Allen, Md. In this case the invention relates to telpher systems and is particularly applicable to rural mail delivering routes in which the delivery points are relatively far apart. It may be used also as a parcel delivering system or for any purpose in which the rapid transportation of light matter is desirable.

HEAD-GEAR FOR SUPPORTING LIGHTS.—D. E. TAYLOR, Williamamie, Conn. The gear is for use by surgeons, dentists, and opticians, and supports an electric light and delivers the rays directly upon the object under inspection. The main feature involves a spring metal band, adapted to extend over the head from the front to the back, and be retained in position by resilient engagement with the forehead and back of the head.

#### Of Interest to Farmers.

BEEHIVE.—P. WEAVER, Fort Worth, Texas. The object among others here is to provide a hive of concrete or cement whose walls will be thick enough to exclude heat and cold, and whose interior will be large enough to receive any desired form of honey frames and which will afford at its entrance ventilating means, cleaning out means, and means for the passage of the bees into and out of the hive.

PEA-HULLER.—W. L. HAY, Franklin, Tenn. The intention of this inventor is to provide a device of comparatively simple construction in which the hulling of picked peas or of peas on the vines may be accomplished by merely shifting the concave and feeding the peas through the device in the direction most suitable for their proper treatment.

DEVICE FOR TEACHING MILKING.—P. J. DEVRIES, Hull, Iowa. The purpose of the improvement is to provide a device that simulates the udder and teats of a cow pendant therefrom, together with other details that afford means for practicing the removal of water from the artificial udder by a proper compression of the teats, and thus acquire the art of milking quickly and safely.

#### Of General Interest.

SOLDER FOR ALUMINIUM.—J. E. GUGENBUHL, 22 Rue de Baguolles, Paris, France. This solder is not easily broken and it readily resists the action of acid and water. It may be used for soldering pieces of pure aluminium or of the alloys thereof, or for soldering aluminium upon copper, zinc, steel and other metals, regardless of the general shape and thickness of the parts.

BUTTER AND LARD CUTTER.—C. H. CARLSON, Iron Mountain, Mich. The invention is an improvement in self measuring lard and butter scoops for use in taking lard or butter out of barrels, tubs, or other receptacles. The blades may be made of different sizes to measure different quantities of the material.

and the blades or other portions of the device may be of any suitable metal or material.

**DISPLAY STAND.**—J. TOWLE, Oremont, Ga. The invention pertains to stands for postal cards and similar articles, and more particularly to one having a number of leaves or partitions movably supported upon a suitable standard, and having the surfaces perforated to permit clips for holding the cards or other articles to be inserted at a number of points and in different positions.

**METHOD FOR PROTECTING GROWING PLANTS AND VEGETABLES.**—E. R. DRAKE, De Land, Fla. In this case the improved method of growing plants consists, first, in protecting the plant-bed on its several sides, but leaving the same open and exposed above; next, when the plants have grown to a considerable height, raising the protecting parts correspondingly, and also shading the plants along the sides and overhead.

#### Railways and Their Accessories.

**SEAL.**—R. A. EDGAR, Iola, Kan. The device is especially intended for sealing railway cars and the like, and the initials of the railroad or the firm using the seal may be embossed on the annular space between the dished portion and the periphery of the disks. The leaden seal may be impressed with the station number or other suitable designation showing where the seal is placed.

**RAILWAY-TIE AND RAIL-CLAMP.**—W. C. NEEL, Lakin, Kan. The aim of the invention is to produce a tie, having an improved form, and particularly adapted to be constructed of metal. A further object is to produce a clamp to be used in connection with a metal tie, and which will operate effectively to hold the rail in position without the use of spikes or similar fastening devices.

**CAR-DOOR OPERATOR.**—F. F. UNSCHICH and C. L. SEELY, Grillon, Ohio. The invention relates more particularly to a car having a plurality of doors, a controlling member, operable from various points of the car for simultaneously opening and closing the doors, and connections between the members and the doors, parts of the connections being adapted to be inseparably disposed so that the controlling member can be rendered inoperative with respect to any one of the doors.

#### Pertaining to Recreation.

**PUZZLE.**—R. D. CLOVER, Weston, Colo. The present object is to provide a puzzle with an outer run way and inner run way surrounding goals, with gates in the run ways and goals, so disposed that considerable skill is required to roll balls from the run ways through the gates

and inner run ways to dispose the balls in the respective goals.

**GAME APPARATUS.**—W. H. CORNBIRD, Mornington, Victoria, Australia. The invention consists in the construction and arrangement of parts constituting a game apparatus. A board or table is provided upon which are placed miniature forts, men, castles, and numerous objects. Toy shooters are provided fitted with spring mechanism adapted to project peas, shots, or pellets through ports from the four corners of the board against the forts, men, and flags.

#### Pertaining to Vehicles.

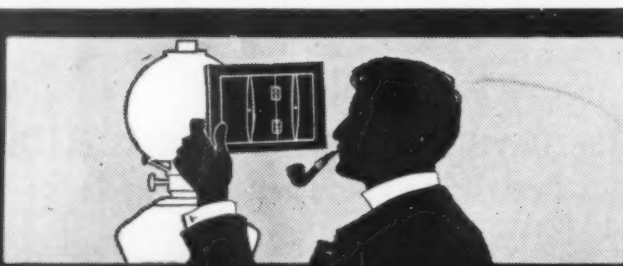
**DETACHABLE RIM FOR PNEUMATIC OR OTHER TIRES.**—M. A. LEMERCIER, 112 Rue de Richelieu, Paris, France. In this patent the invention has reference to a detachable rim which allows a complete pneumatic tire fully inflated, or a solid India rubber tire, mounted on said detachable rim to be attached to or detached from the wheel of a vehicle with great rapidity.

**CASING FOR PNEUMATIC TIRES.**—J. H. SEIDERLING, Jonesboro, Ind. The casing is arranged to permit its convenient or ready application on either single clench or double clench style of wooden rim, it being provided for this purpose with separable abutting edges and single exterior locking ribs arranged at equal distances from the edges, the portion of the casing extending from the base of each rib to the corresponding edge gradually diminishing in thickness and forming a pliable non-clenching closing flange.

**VEHICLE-WHEEL.**—W. L. HOWARD, Trenton, N. J. The invention relates more particularly to the mechanism for rigidly locking the rim in place yet permitting of its ready removal. It is particularly adapted for vehicle wheels having pneumatic tires carried by the rims, the object being to facilitate the removal of the rim and tire and the substitution of a new rim and tire in case of puncture or other injury.

**SPEED-GAGE.**—O. D. MUNN and J. K. BRACHVOGEL, New York, N. Y. The invention is particularly useful in connection with devices intended for measuring the speed of railroad trains, automobiles, and the like. An object is to provide a gage by means of which the speed of moving bodies can be measured with accuracy, and which is insensitive to shocks and concussions. A circulating fluid medium is employed, which is sensitive to extremely slight changes in the degree of velocity of the moving body.

**NOTE.**—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.



## It Fits

There's one paper that is made solely to meet the requirements of the amateur—a paper that has the quality that gives the best results from amateur negatives:—

# VELOX

If you do your own printing, Velox will be easiest for you to work because it fits your negatives. If you have a professional finish your work, he can give you the best results on Velox—because it fits your negatives.

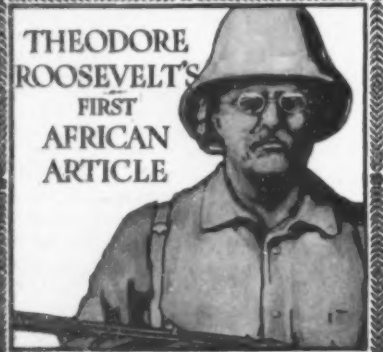
There's a wide variety in surfaces, weights and grades.

*If your developer and finisher doesn't use Velox, write us; we will tell you of one who does.*

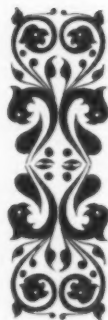
**NEPERA DIVISION,**  
Eastman Kodak Company,  
ROCHESTER, N. Y.

## SCRIBNER'S MAGAZINE

THEODORE ROOSEVELT'S  
FIRST  
AFRICAN  
ARTICLE



CHARLES SCRIBNER'S SONS NEW YORK



## Mr. Roosevelt's

own account of his

## African Trip

(to run a year) will appear  
exclusively in

**SCRIBNER'S  
MAGAZINE**

The First Article

## A RAILROAD THROUGH THE PLEISTOCENE

in the October Number

describes the start of the famous expedition—the wondrous railway journey through a country that was like a “great zoological garden,” the black tribesmen of his caravan, his outfit, guns, tents, his first hunting experiences, etc., etc. The illustrations from photographs by Kermit Roosevelt and other members of the party.

To meet the extraordinary advance demand for these articles the publishers have provided a very large edition of this first number, but it will be well to place your order for a year's subscription at once in order to be sure of obtaining the complete series. Any person who can secure subscriptions can make money on Scribner's this year. Liberal cash commissions and cash prizes. Write NOW for particulars. 25 cents a number; \$3.00 a year.

CHARLES SCRIBNER'S SONS, NEW YORK







# Blame the Strop!

How about the strop behind your razor?  
How about your ability to use it?  
Is every shave a pleasure now?

The NEVER FAIL sharpens any razor—does it better and in less time than a hand expert can, and gives the keenest, smoothest cutting edge you ever saw.

A Western bank president (name on application) writes: "Have used one... blade over six weeks, and I shave daily. One box of blades with your stropper should last a lifetime. Wouldn't part with mine for \$50."

WILL YOU TRY IT FOR 15 DAYS?

Money back if you want it—ask any bank in this city as to our responsibility.

Put on the market only four months ago, after years' of experimenting, thousands of NEVER FAIL STROPPERS sent out on trial have triumphantly proved their worth in every state in the Union. The combination of a perfect strop with an infallible, automatic action is a real necessity for every man who shaves—or should shave. Every consideration of economy and personal comfort urges you to supply yourself today.

Every user of safety razors knows that mighty few—if any—of his blades are actually fit to use until they are stropped. The NEVER FAIL will make every one of them good for from 50 to 150 perfect shaves, so it pays for itself in money as well as time saved.

Order by number, with the coupon below.

No. 1—for every style of safety  
No. 2—for the old style razor

The Never Fail Co.

1052 Nicholas Bldg.

TOLEDO

OHIO



## "The Thurman"



### A Portable Electric Vacuum Cleaner that CLEANS

NOT A TOY BUT IN EVERY SENSE OF THE WORD A MACHINE  
Built by the originators and the oldest and largest manufacturers of vacuum cleaning machinery in the world, and used by the most particular people. Guaranteed to do thorough and efficient work. Write for booklet giving full particulars and prices.  
GEN'L COMPRESSED AIR & VACUUM MACHINERY CO.  
Dept. S. A., 519 No. Taylor Ave., St. Louis, Mo., U. S. A.  
(Representatives wanted in every community)

THE INTERNAL WORK OF THE Wind. By S. P. LANGLEY. A painstaking discussion by the leading authority on Aerodynamics, of a subject of value to all interested in aerobics. SCIENTIFIC AMERICAN SUPPLEMENTS 946 and 947. Price 10 cents each, by mail. Munn & Co., Inc., 361 Broadway, New York City, and all newsdealers.

### HANDY IN EVERY HOME

Everybody who sees this useful and pretty little novelty wants one of the  
Excellent Combination Tweezers and Magnifying Glass

No toy, but a practically useful article that is indispensable in every household. A powerful magnifying glass enlarges the object the tweezers are to work on, rendering it easy to extract splinters or hairs. Nickel plated and highly polished. Also useful for mill workers, jewelers, botanists, physicians, etc.  
By mail 12, 25 and 50c. 2 dms  
A. Kleinman, Sole Mfr., 250 8th Ave., N. Y.



### Essex Hot Air Engines

SMALL SIZE, 1/2 TO 1 H. P.

Ideal for Light Power Purposes

Write us for Catalogue

ESSEX & SMITH CO.

6 and 8 Lock Street, Buffalo, N. Y.



Made in the largest and most up-to-date plant in the world devoted exclusively to the manufacture of two-cycle marine motors.

Wire your order and have motor shipped same day  
This is only possible because of our enormous output.



Write for our beautiful three-color catalog—it's an education in marine motors.

Stocks of Gray Motors carried in Boston, New York, Philadelphia, Baltimore, Norfolk, New Orleans, St. Louis, Chicago, Los Angeles, San Francisco, Seattle, Toronto and St. John.

GRAY MOTOR CO., 11 LaSalle Street, Detroit, Mich.

Write for catalog of boat and engine accessories.

See large magazine advertisements.

The New High Class Watch

Ingersoll-Trenton

A high-grade watch manufactured by the money-saving system of the Ingersoll-Trenton Watch. Has every feature of the most expensive watches. Closest timekeeper; none handsomer made; will wear 20 years. Buy it from any responsible jeweler right in your own locality or prepaid by mail. Write for Booklet C.

\$5 in solid gold \$7 in rose gold \$9 in rose gold \$11 in rose gold \$13 in rose gold \$15 in rose gold \$17 in rose gold \$19 in rose gold \$21 in rose gold \$23 in rose gold \$25 in rose gold \$27 in rose gold \$29 in rose gold \$31 in rose gold \$33 in rose gold \$35 in rose gold \$37 in rose gold \$39 in rose gold \$41 in rose gold \$43 in rose gold \$45 in rose gold \$47 in rose gold \$49 in rose gold \$51 in rose gold \$53 in rose gold \$55 in rose gold \$57 in rose gold \$59 in rose gold \$61 in rose gold \$63 in rose gold \$65 in rose gold \$67 in rose gold \$69 in rose gold \$71 in rose gold \$73 in rose gold \$75 in rose gold \$77 in rose gold \$79 in rose gold \$81 in rose gold \$83 in rose gold \$85 in rose gold \$87 in rose gold \$89 in rose gold \$91 in rose gold \$93 in rose gold \$95 in rose gold \$97 in rose gold \$99 in rose gold \$101 in rose gold \$103 in rose gold \$105 in rose gold \$107 in rose gold \$109 in rose gold \$111 in rose gold \$113 in rose gold \$115 in rose gold \$117 in rose gold \$119 in rose gold \$121 in rose gold \$123 in rose gold \$125 in rose gold \$127 in rose gold \$129 in rose gold \$131 in rose gold \$133 in rose gold \$135 in rose gold \$137 in rose gold \$139 in rose gold \$141 in rose gold \$143 in rose gold \$145 in rose gold \$147 in rose gold \$149 in rose gold \$151 in rose gold \$153 in rose gold \$155 in rose gold \$157 in rose gold \$159 in rose gold \$161 in rose gold \$163 in rose gold \$165 in rose gold \$167 in rose gold \$169 in rose gold \$171 in rose gold \$173 in rose gold \$175 in rose gold \$177 in rose gold \$179 in rose gold \$181 in rose gold \$183 in rose gold \$185 in rose gold \$187 in rose gold \$189 in rose gold \$191 in rose gold \$193 in rose gold \$195 in rose gold \$197 in rose gold \$199 in rose gold \$201 in rose gold \$203 in rose gold \$205 in rose gold \$207 in rose gold \$209 in rose gold \$211 in rose gold \$213 in rose gold \$215 in rose gold \$217 in rose gold \$219 in rose gold \$221 in rose gold \$223 in rose gold \$225 in rose gold \$227 in rose gold \$229 in rose gold \$231 in rose gold \$233 in rose gold \$235 in rose gold \$237 in rose gold \$239 in rose gold \$241 in rose gold \$243 in rose gold \$245 in rose gold \$247 in rose gold \$249 in rose gold \$251 in rose gold \$253 in rose gold \$255 in rose gold \$257 in rose gold \$259 in rose gold \$261 in rose gold \$263 in rose gold \$265 in rose gold \$267 in rose gold \$269 in rose gold \$271 in rose gold \$273 in rose gold \$275 in rose gold \$277 in rose gold \$279 in rose gold \$281 in rose gold \$283 in rose gold \$285 in rose gold \$287 in rose gold \$289 in rose gold \$291 in rose gold \$293 in rose gold \$295 in rose gold \$297 in rose gold \$299 in rose gold \$301 in rose gold \$303 in rose gold \$305 in rose gold \$307 in rose gold \$309 in rose gold \$311 in rose gold \$313 in rose gold \$315 in rose gold \$317 in rose gold \$319 in rose gold \$321 in rose gold \$323 in rose gold \$325 in rose gold \$327 in rose gold \$329 in rose gold \$331 in rose gold \$333 in rose gold \$335 in rose gold \$337 in rose gold \$339 in rose gold \$341 in rose gold \$343 in rose gold \$345 in rose gold \$347 in rose gold \$349 in rose gold \$351 in rose gold \$353 in rose gold \$355 in rose gold \$357 in rose gold \$359 in rose gold \$361 in rose gold \$363 in rose gold \$365 in rose gold \$367 in rose gold \$369 in rose gold \$371 in rose gold \$373 in rose gold \$375 in rose gold \$377 in rose gold \$379 in rose gold \$381 in rose gold \$383 in rose gold \$385 in rose gold \$387 in rose gold \$389 in rose gold \$391 in rose gold \$393 in rose gold \$395 in rose gold \$397 in rose gold \$399 in rose gold \$401 in rose gold \$403 in rose gold \$405 in rose gold \$407 in rose gold \$409 in rose gold \$411 in rose gold \$413 in rose gold \$415 in rose gold \$417 in rose gold \$419 in rose gold \$421 in rose gold \$423 in rose gold \$425 in rose gold \$427 in rose gold \$429 in rose gold \$431 in rose gold \$433 in rose gold \$435 in rose gold \$437 in rose gold \$439 in rose gold \$441 in rose gold \$443 in rose gold \$445 in rose gold \$447 in rose gold \$449 in rose gold \$451 in rose gold \$453 in rose gold \$455 in rose gold \$457 in rose gold \$459 in rose gold \$461 in rose gold \$463 in rose gold \$465 in rose gold \$467 in rose gold \$469 in rose gold \$471 in rose gold \$473 in rose gold \$475 in rose gold \$477 in rose gold \$479 in rose gold \$481 in rose gold \$483 in rose gold \$485 in rose gold \$487 in rose gold \$489 in rose gold \$491 in rose gold \$493 in rose gold \$495 in rose gold \$497 in rose gold \$499 in rose gold \$501 in rose gold \$503 in rose gold \$505 in rose gold \$507 in rose gold \$509 in rose gold \$511 in rose gold \$513 in rose gold \$515 in rose gold \$517 in rose gold \$519 in rose gold \$521 in rose gold \$523 in rose gold \$525 in rose gold \$527 in rose gold \$529 in rose gold \$531 in rose gold \$533 in rose gold \$535 in rose gold \$537 in rose gold \$539 in rose gold \$541 in rose gold \$543 in rose gold \$545 in rose gold \$547 in rose gold \$549 in rose gold \$551 in rose gold \$553 in rose gold \$555 in rose gold \$557 in rose gold \$559 in rose gold \$561 in rose gold \$563 in rose gold \$565 in rose gold \$567 in rose gold \$569 in rose gold \$571 in rose gold \$573 in rose gold \$575 in rose gold \$577 in rose gold \$579 in rose gold \$581 in rose gold \$583 in rose gold \$585 in rose gold \$587 in rose gold \$589 in rose gold \$591 in rose gold \$593 in rose gold \$595 in rose gold \$597 in rose gold \$599 in rose gold \$601 in rose gold \$603 in rose gold \$605 in rose gold \$607 in rose gold \$609 in rose gold \$611 in rose gold \$613 in rose gold \$615 in rose gold \$617 in rose gold \$619 in rose gold \$621 in rose gold \$623 in rose gold \$625 in rose gold \$627 in rose gold \$629 in rose gold \$631 in rose gold \$633 in rose gold \$635 in rose gold \$637 in rose gold \$639 in rose gold \$641 in rose gold \$643 in rose gold \$645 in rose gold \$647 in rose gold \$649 in rose gold \$651 in rose gold \$653 in rose gold \$655 in rose gold \$657 in rose gold \$659 in rose gold \$661 in rose gold \$663 in rose gold \$665 in rose gold \$667 in rose gold \$669 in rose gold \$671 in rose gold \$673 in rose gold \$675 in rose gold \$677 in rose gold \$679 in rose gold \$681 in rose gold \$683 in rose gold \$685 in rose gold \$687 in rose gold \$689 in rose gold \$691 in rose gold \$693 in rose gold \$695 in rose gold \$697 in rose gold \$699 in rose gold \$701 in rose gold \$703 in rose gold \$705 in rose gold \$707 in rose gold \$709 in rose gold \$711 in rose gold \$713 in rose gold \$715 in rose gold \$717 in rose gold \$719 in rose gold \$721 in rose gold \$723 in rose gold \$725 in rose gold \$727 in rose gold \$729 in rose gold \$731 in rose gold \$733 in rose gold \$735 in rose gold \$737 in rose gold \$739 in rose gold \$741 in rose gold \$743 in rose gold \$745 in rose gold \$747 in rose gold \$749 in rose gold \$751 in rose gold \$753 in rose gold \$755 in rose gold \$757 in rose gold \$759 in rose gold \$761 in rose gold \$763 in rose gold \$765 in rose gold \$767 in rose gold \$769 in rose gold \$771 in rose gold \$773 in rose gold \$775 in rose gold \$777 in rose gold \$779 in rose gold \$781 in rose gold \$783 in rose gold \$785 in rose gold \$787 in rose gold \$789 in rose gold \$791 in rose gold \$793 in rose gold \$795 in rose gold \$797 in rose gold \$799 in rose gold \$801 in rose gold \$803 in rose gold \$805 in rose gold \$807 in rose gold \$809 in rose gold \$811 in rose gold \$813 in rose gold \$815 in rose gold \$817 in rose gold \$819 in rose gold \$821 in rose gold \$823 in rose gold \$825 in rose gold \$827 in rose gold \$829 in rose gold \$831 in rose gold \$833 in rose gold \$835 in rose gold \$837 in rose gold \$839 in rose gold \$841 in rose gold \$843 in rose gold \$845 in rose gold \$847 in rose gold \$849 in rose gold \$851 in rose gold \$853 in rose gold \$855 in rose gold \$857 in rose gold \$859 in rose gold \$861 in rose gold \$863 in rose gold \$865 in rose gold \$867 in rose gold \$869 in rose gold \$871 in rose gold \$873 in rose gold \$875 in rose gold \$877 in rose gold \$879 in rose gold \$881 in rose gold \$883 in rose gold \$885 in rose gold \$887 in rose gold \$889 in rose gold \$891 in rose gold \$893 in rose gold \$895 in rose gold \$897 in rose gold \$899 in rose gold \$901 in rose gold \$903 in rose gold \$905 in rose gold \$907 in rose gold \$909 in rose gold \$911 in rose gold \$913 in rose gold \$915 in rose gold \$917 in rose gold \$919 in rose gold \$921 in rose gold \$923 in rose gold \$925 in rose gold \$927 in rose gold \$929 in rose gold \$931 in rose gold \$933 in rose gold \$935 in rose gold \$937 in rose gold \$939 in rose gold \$941 in rose gold \$943 in rose gold \$945 in rose gold \$947 in rose gold \$949 in rose gold \$951 in rose gold \$953 in rose gold \$955 in rose gold \$957 in rose gold \$959 in rose gold \$961 in rose gold \$963 in rose gold \$965 in rose gold \$967 in rose gold \$969 in rose gold \$971 in rose gold \$973 in rose gold \$975 in rose gold \$977 in rose gold \$979 in rose gold \$981 in rose gold \$983 in rose gold \$985 in rose gold \$987 in rose gold \$989 in rose gold \$991 in rose gold \$993 in rose gold \$995 in rose gold \$997 in rose gold \$999 in rose gold \$1001 in rose gold \$1003 in rose gold \$1005 in rose gold \$1007 in rose gold \$1009 in rose gold \$1011 in rose gold \$1013 in rose gold \$1015 in rose gold \$1017 in rose gold \$1019 in rose gold \$1021 in rose gold \$1023 in rose gold \$1025 in rose gold \$1027 in rose gold \$1029 in rose gold \$1031 in rose gold \$1033 in rose gold \$1035 in rose gold \$1037 in rose gold \$1039 in rose gold \$1041 in rose gold \$1043 in rose gold \$1045 in rose gold \$1047 in rose gold \$1049 in rose gold \$1051 in rose gold \$1053 in rose gold \$1055 in rose gold \$1057 in rose gold \$1059 in rose gold \$1061 in rose gold \$1063 in rose gold \$1065 in rose gold \$1067 in rose gold \$1069 in rose gold \$1071 in rose gold \$1073 in rose gold \$1075 in rose gold \$1077 in rose gold \$1079 in rose gold \$1081 in rose gold \$1083 in rose gold \$1085 in rose gold \$1087 in rose gold \$1089 in rose gold \$1091 in rose gold \$1093 in rose gold \$1095 in rose gold \$1097 in rose gold \$1099 in rose gold \$1101 in rose gold \$1103 in rose gold \$1105 in rose gold \$1107 in rose gold \$1109 in rose gold \$1111 in rose gold \$1113 in rose gold \$1115 in rose gold \$1117 in rose gold \$1119 in rose gold \$1121 in rose gold \$1123 in rose gold \$1125 in rose gold \$1127 in rose gold \$1129 in rose gold \$1131 in rose gold \$1133 in rose gold \$1135 in rose gold \$1137 in rose gold \$1139 in rose gold \$1141 in rose gold \$1143 in rose gold \$1145 in rose gold \$1147 in rose gold \$1149 in rose gold \$1151 in rose gold \$1153 in rose gold \$1155 in rose gold \$1157 in rose gold \$1159 in rose gold \$1161 in rose gold \$1163 in rose gold \$1165 in rose gold \$1167 in rose gold \$1169 in rose gold \$1171 in rose gold \$1173 in rose gold \$1175 in rose gold \$1177 in rose gold \$1179 in rose gold \$1181 in rose gold \$1183 in rose gold \$1185 in rose gold \$1187 in rose gold \$1189 in rose gold \$1191 in rose gold \$1193 in rose gold \$1195 in rose gold \$1197 in rose gold \$1199 in rose gold \$1201 in rose gold \$1203 in rose gold \$1205 in rose gold \$1207 in rose gold \$1209 in rose gold \$1211 in rose gold \$1213 in rose gold \$1215 in rose gold \$1217 in rose gold \$1219 in rose gold \$1221 in rose gold \$1223 in rose gold \$1225 in rose gold \$1227 in rose gold \$1229 in rose gold \$1231 in rose gold \$1233 in rose gold \$1235 in rose gold \$1237 in rose gold \$1239 in rose gold \$1241 in rose gold \$1243 in rose gold \$1245 in rose gold \$1247 in rose gold \$1249 in rose gold \$1251 in rose gold \$1253 in rose gold \$1255 in rose gold \$1257 in rose gold \$1259 in rose gold \$1261 in rose gold \$1263 in rose gold \$1265 in rose gold \$1267 in rose gold \$1269 in rose gold \$1271 in rose gold \$1273 in rose gold \$1275 in rose gold \$1277 in rose gold \$1279 in rose gold \$1281 in rose gold \$1283 in rose gold \$1285 in rose gold \$1287 in rose gold \$1289 in rose gold \$1291 in rose gold \$1293 in rose gold \$1295 in rose gold \$1297 in rose gold \$1299 in rose gold \$1301 in rose gold \$1303 in rose gold \$1305 in rose gold \$1307 in rose gold \$1309 in rose gold \$1311 in rose gold \$1313 in rose gold \$1315 in rose gold \$1317 in rose gold \$1319 in rose gold \$1321 in rose gold \$1323 in rose gold \$1325 in rose gold \$1327 in rose gold \$1329 in rose gold \$1331 in rose gold \$1333 in rose gold \$1335 in rose gold \$1337 in rose gold \$1339 in rose gold \$1341 in rose gold \$1343 in rose gold \$1345 in rose gold \$1347 in rose gold \$1349 in rose gold \$1351 in rose gold \$1353 in rose gold \$1355 in rose gold \$1357 in rose gold \$1359 in rose gold \$1361 in rose gold \$1363 in rose gold \$1365 in rose gold \$1367 in rose gold \$1369 in rose gold \$1371 in rose gold \$1373 in rose gold \$1375 in rose gold \$1377 in rose gold \$1379 in rose gold \$1381 in rose gold \$1383 in rose gold \$1385 in rose gold \$1387 in rose gold \$1389 in rose gold \$1391 in rose gold \$1393 in rose gold \$1395 in rose gold \$1397 in rose gold \$1399 in rose gold \$1401 in rose gold \$1403 in rose gold \$1405 in rose gold \$1407 in rose gold \$1409 in rose gold \$1411 in rose gold \$1413 in rose gold \$1415 in rose gold \$1417 in rose gold \$1419 in rose gold \$1421 in rose gold \$1423 in rose gold \$1425 in rose gold \$1427 in rose gold \$1429 in rose gold \$1431 in rose gold \$1433 in rose gold \$1435 in rose gold \$1437 in rose gold \$1439 in rose gold \$1441 in rose gold \$1443 in rose gold \$1445 in rose gold \$1447 in rose gold \$1449 in rose gold \$1451 in rose gold \$1453 in rose gold \$1455 in rose gold \$1457 in rose gold \$1459 in rose gold \$1461 in rose gold \$1463 in rose gold \$1465 in rose gold \$1467 in rose gold \$1469 in rose gold \$1471 in rose gold \$1473 in rose gold \$1475 in rose gold \$1477 in rose gold \$1479 in rose gold \$1481 in rose gold \$1483 in rose gold \$1485 in rose gold \$1487 in rose gold \$1489 in rose gold \$1491 in rose gold \$1493 in rose gold \$1495 in rose gold \$1497 in rose gold \$1499 in rose gold \$1501 in rose gold \$1503 in rose gold \$1505 in rose gold \$1507 in rose gold \$1509 in rose gold \$1511 in rose gold \$1513 in rose gold \$1515 in rose gold \$1517 in rose gold \$1519 in rose gold \$1521 in rose gold \$1523 in rose gold \$1525 in rose gold \$1527 in rose gold \$1529 in rose gold \$1531 in rose gold \$1533 in rose gold \$1535 in rose gold \$1537 in rose gold \$1539 in rose gold \$1541 in rose gold \$1543 in rose gold \$1545 in rose gold \$1547 in rose gold \$1549 in rose gold \$1551 in rose gold \$1553 in rose gold \$1555 in rose gold \$1557 in rose gold \$1559 in rose gold \$1561 in rose gold \$1563 in rose gold \$1565 in rose gold \$1567 in rose gold \$1569 in rose gold \$1571 in rose gold \$1573 in rose gold \$1575 in rose gold \$1577 in rose gold \$1579 in rose gold \$1581 in rose gold \$1583 in rose gold \$1585 in rose gold \$1587 in rose gold \$1589 in rose gold \$1591 in rose gold \$1593 in rose gold \$1595 in rose gold \$1597 in rose gold \$1599 in rose gold \$1601 in rose gold \$1603 in rose gold \$1605 in rose gold \$1607 in rose gold \$1609 in rose gold \$1611 in rose gold \$1613 in rose gold \$1615 in rose gold \$1617 in rose gold \$1619 in rose gold \$1621 in rose gold \$1623 in rose gold \$1625 in rose gold \$1627 in rose gold \$1629 in rose gold \$1631 in rose gold \$1633 in rose gold \$1635 in rose gold \$1637 in rose gold \$1639 in rose gold \$1641 in rose gold \$1643 in rose gold \$1645 in rose gold \$1647 in rose gold \$1649 in rose gold \$1651 in rose gold \$1653 in rose gold \$1655 in rose gold \$1657 in rose gold \$1659 in rose gold \$1661 in rose gold \$1663 in rose gold \$1665 in rose gold \$1667 in rose gold \$1669 in rose gold \$1671 in rose gold \$1673 in rose gold \$1675 in rose gold \$1677 in rose gold \$1679 in rose gold \$1681 in rose gold \$1683 in rose gold \$1685 in rose gold \$1687 in rose gold \$1689 in rose gold \$1691 in rose gold \$1693 in rose gold \$1695 in rose gold \$1697 in rose gold \$1699 in rose gold \$1701 in rose gold \$1703 in rose gold \$1705 in rose gold \$1707 in rose gold \$1709 in rose gold \$1711 in rose gold \$1713 in rose gold \$1715 in rose gold \$1717 in rose gold \$1719 in rose gold \$1721 in rose gold \$1723 in rose gold \$1725 in rose gold \$1727 in rose gold \$1729 in rose gold \$1731 in rose gold \$1733 in rose gold \$1735 in rose gold \$1737 in rose gold \$1739 in rose gold \$1741 in rose gold \$1743 in rose gold \$1745 in rose gold \$1747 in rose gold \$1749 in rose gold \$1751 in rose gold \$1753 in rose gold \$1755 in rose gold \$1757 in rose gold \$1759 in rose gold \$1761 in rose gold \$1763 in rose gold \$1765 in rose gold \$1767 in rose gold \$1769 in rose gold \$1771 in rose gold \$1773 in rose gold \$1775 in rose gold \$1777 in rose gold \$1779 in rose gold \$1781 in rose gold \$1783 in rose gold \$1785 in rose gold \$1787 in rose gold \$1789 in rose gold \$1791 in rose gold \$1793 in rose gold \$1795 in rose gold \$1797 in rose gold \$1799 in rose gold \$1801 in rose gold \$1803 in rose gold \$1805 in rose gold \$1807 in rose gold \$1809 in rose gold \$1811 in rose gold \$1813 in rose gold \$1815 in rose gold \$1817 in rose gold \$1819 in rose gold \$1821 in rose gold \$1823 in rose gold \$1825 in rose gold \$1827 in rose gold \$1829 in rose gold \$1831 in rose gold \$1833 in rose gold \$1835 in rose gold \$1837 in rose gold \$1839 in rose gold \$1841 in rose gold \$1843 in rose gold \$1845 in rose gold \$1847 in rose gold \$1849 in rose gold \$1851 in rose gold \$1853 in rose gold \$1855 in rose gold \$1857 in rose gold \$1859 in rose gold \$1861 in rose gold \$1863 in rose gold \$1865 in rose gold \$1867 in rose gold \$1869 in rose gold \$1871 in rose gold \$1873 in rose gold \$1875 in rose gold \$1877 in rose gold \$1879 in rose gold \$1881 in rose gold \$1883 in rose gold \$1885 in rose gold \$1887 in rose gold \$1889 in rose gold \$1891 in rose gold \$1893 in rose gold \$1895 in rose gold \$1897 in rose gold \$1899 in rose gold \$1901 in rose gold \$1903 in rose gold \$1905 in rose gold \$1907 in rose gold \$1909 in rose gold \$1911 in rose gold \$1913 in rose gold \$1915 in rose gold \$1917 in rose gold \$1919 in rose gold \$1921 in rose gold \$1923 in rose gold \$1925 in rose gold \$1927 in rose gold \$1929 in rose gold \$1931 in rose gold \$1933 in rose gold \$1935 in rose gold \$1937 in rose gold \$1939 in rose gold \$1941 in rose gold \$1943 in rose gold \$1945 in rose gold \$1947 in rose gold \$1949 in rose gold \$1951 in rose gold \$1953 in rose gold \$1955 in rose gold \$1957 in rose gold \$1959 in rose gold \$1961 in rose gold \$1963 in rose gold \$1965 in rose gold \$1967 in rose gold \$1969 in rose gold \$1971 in rose gold \$1973 in rose gold \$1975 in rose gold \$1977 in rose gold \$1979 in rose gold \$1981 in rose gold \$1983 in rose gold \$1985 in rose gold \$1987 in rose gold \$1989 in rose gold \$1991 in rose gold \$1993 in rose gold \$1995 in rose gold \$1997 in rose gold \$1999 in rose gold \$2001 in rose gold \$2003 in rose gold \$2005 in rose gold \$2007 in rose gold \$2009 in rose gold \$2011 in rose gold \$2013 in rose gold \$2015 in rose gold \$2017 in rose gold \$2019 in rose gold \$2021 in rose gold \$2023 in rose gold \$2025 in rose gold \$2027 in rose gold \$2029 in rose gold \$2031 in rose gold \$2033 in rose gold \$2035 in rose gold \$2037 in rose gold \$2039 in rose gold \$2041 in rose gold \$2043 in rose gold \$2045 in rose gold \$2047 in rose gold \$2049 in rose gold \$2051 in rose gold \$2053 in rose gold \$2055 in rose gold \$2057 in rose gold \$2059 in rose gold \$2061 in rose gold \$2063 in rose gold \$2065 in rose gold \$2067 in rose gold \$2069 in rose gold \$2071 in rose gold \$2073 in rose gold \$2075 in rose gold \$2077 in rose gold \$2079 in rose gold \$2081 in rose gold \$2083 in rose gold \$2085 in rose gold \$2087 in rose gold \$2089 in rose gold \$2091 in rose gold \$2093 in rose gold \$2095 in rose gold \$2097 in rose gold \$2099 in rose gold \$2101 in rose gold \$2103 in rose gold \$2105 in rose gold \$2107 in rose gold \$2109 in rose gold \$2111 in rose gold \$2113 in rose gold \$2115 in rose gold \$2117 in rose gold \$2119 in rose gold \$2121 in rose gold \$2123 in rose gold \$2125 in rose gold \$2127 in rose gold \$2129 in rose gold \$2131 in rose gold \$2133 in rose gold \$2135 in rose gold \$2137 in rose gold \$2139 in rose gold \$2141 in rose gold \$2143 in rose gold \$2145 in rose gold \$2147 in rose gold \$2149 in rose gold \$2151 in rose gold \$2153 in rose gold \$2155 in rose gold \$2157 in rose gold \$2159 in rose gold \$2161 in rose gold \$2163 in rose gold \$2165 in rose gold \$2167 in rose gold \$2169 in rose gold \$2171 in rose gold \$2173 in rose gold \$2175 in rose gold \$2177 in rose gold \$2179 in rose gold \$2181 in rose gold \$2183 in rose gold \$2185 in rose gold \$2187 in rose gold \$2189 in rose gold \$2191 in rose gold \$2193 in rose gold \$2195 in rose gold \$2197 in rose gold \$2199 in rose gold \$2201 in rose gold \$2203 in rose gold \$2205 in rose gold \$2207 in rose gold \$2209 in rose gold \$2211 in rose gold \$2213 in rose gold \$2215 in rose gold \$2217 in rose gold \$2219 in rose gold \$2221 in rose gold \$2223 in rose gold \$2225 in rose gold \$2227 in rose gold \$2229 in rose gold \$2231 in rose gold \$2233 in rose gold \$2235 in rose gold \$2237 in rose gold \$2239 in rose gold \$2241 in rose gold \$2243 in rose gold \$2245 in rose gold \$2247 in rose gold \$2249 in rose gold \$2251 in rose gold \$2253 in rose gold \$2255 in rose gold \$2257 in rose gold \$2259 in rose gold \$2261 in rose gold \$2263 in rose gold \$2265 in rose gold \$2267 in rose gold \$2269 in rose gold \$2271 in rose gold \$2273 in rose gold \$2275 in rose gold \$2277 in rose gold \$2279 in rose gold \$2281 in rose gold \$2283 in rose gold \$2285 in rose gold \$2287 in rose gold \$2289 in rose gold \$2291 in rose gold \$2293 in rose gold \$2295 in rose gold \$2297 in rose gold \$2299 in rose gold \$2301 in rose gold \$2303 in rose gold \$2305 in rose gold \$2307 in rose gold \$2309 in rose gold \$2311 in rose gold \$2313 in rose gold \$2315 in rose gold \$2317 in rose gold \$2319 in rose gold \$2321 in rose gold \$2323 in rose gold \$2325 in rose gold \$2327 in rose gold \$2329 in rose gold \$2331 in rose gold \$2333 in rose gold \$2335 in rose gold \$2337 in rose gold \$2339 in rose gold \$2341 in rose gold \$2343 in rose gold \$2345 in rose gold \$2347 in rose gold \$2349 in rose gold \$2351 in rose gold \$2353 in rose gold \$2355 in rose gold \$2357 in rose gold \$2359 in rose gold \$2361 in rose gold \$2363 in rose gold \$2365 in rose gold \$2367 in rose gold \$2369 in rose gold \$2371 in rose gold \$2373 in rose gold \$2375 in rose gold \$2377 in rose gold \$2379 in rose gold \$2381 in rose gold \$2383 in rose gold \$2385 in rose gold \$2387 in rose gold \$2389 in rose gold \$2391 in rose gold \$2393 in rose gold \$2395 in rose gold \$2397 in rose gold \$2399 in rose gold \$2401 in rose gold \$2403 in rose gold \$2405 in rose gold \$2407 in rose gold \$2409 in rose gold \$2411 in rose gold \$2413 in rose gold \$2415 in rose gold \$2417 in rose gold \$2419 in rose gold \$2421 in rose gold \$2423 in rose gold \$2425 in rose gold \$2427 in rose gold \$2429 in rose gold \$2431 in rose gold \$2433 in rose gold \$2435 in rose gold \$2437 in rose gold \$2439 in rose gold \$2441 in rose gold \$2443 in rose gold \$2445 in rose gold \$2447 in rose gold \$2449 in rose gold \$2451 in rose gold \$2453 in rose gold \$2455 in rose gold \$2457 in rose gold \$2459 in rose gold \$2461 in rose gold \$2463 in rose gold \$2465 in rose gold \$2467 in rose gold \$2469 in rose gold \$2471 in rose gold \$2473 in rose gold \$2475 in rose gold \$2477 in rose gold \$2479 in rose gold \$2481 in rose gold \$2483 in rose gold \$2485 in rose gold \$2487 in rose gold \$2489 in rose gold \$2491 in rose gold \$2493 in rose gold \$2495 in rose gold \$2497 in rose gold \$2499 in rose gold \$2501 in rose gold \$2503 in rose gold \$2505 in rose gold \$2507 in rose gold \$2509 in rose gold \$2511 in rose gold \$2513 in rose gold \$2515 in rose gold \$2517 in rose gold \$2519 in rose gold \$2521 in rose gold \$2523 in rose gold \$2525 in rose gold \$2527 in rose gold \$2529 in rose gold \$2531 in rose gold \$2533 in rose gold \$2535 in rose gold \$2537 in rose gold \$2539 in rose gold \$2541 in rose gold \$2543 in rose gold \$2545 in rose gold \$2547 in rose gold \$2549 in rose gold \$2551 in rose gold



# LILACS

THE CHOICEST VARIETIES

Including the famous HIGHLAND PARK COLLECTION

Catalogue containing descriptions of 85 different kinds will be sent on request. This Catalogue also contains accurate and trustworthy description of the best

Trees, Shrubs and Hardy Plants

ELLWANGER & BARRY, Mount Hope Nurseries, Box 0, Rochester, N. Y.

## FORE RIVER SHIP BUILDING CO.

QUINCY, MASS.



LAUNCH OF U. S. BATTLESHIP "NORTH DAKOTA"

Curtis Marine Turbines Yarrow Water Tube Boilers  
Holland Submarine Boats  
Forgings, Manganese Bronze Castings

IF IT'S WIRELESS WE MAKE IT

**THE COLLINS WIRELESS TELEPHONE COMPANY**

A. FREDERICK COLLINS, President

MAKERS OF—  
WIRELESS TELEPHONE  
WIRELESS TELEGRAPH  
Apparatus of Every Description

Send for Free Catalogue

A Postal will bring you

**The COLLINS WIRELESS BULLETIN**  
DEVOTED EXCLUSIVELY TO WIRELESS

54 and 56 CLINTON STREET  
NEWARK, N. J.

IF WE MAKE IT, IT WORKS

"ORIGIATVS ET BONITAS"

EXTRA QUALITY

**DUNLAP & CO.**

REG. U.S. PAT. OFFICE

**Celebrated Hats**

in authoritative fashions for discriminating dressers.

178-180 Fifth Ave.  
567 Fifth Ave. | 181 Broadway  
Chicago Philadelphia  
The Wellington 914 Chestnut St.

**Ironing Made Easy**

The Simplex Ironer does away with all tired feeling, headache and backache on ironing day. It works so easy and fast a child can turn it. Saves 3/4 the time. The

**SIMPLEX IRONER**

puts a beautiful finish on fine linen, plain clothes, flat work, saves its cost many times over. Costs 1 cent an hour for gas or gasoline heat. Hand or belt power. Write for name of dealer who handles Simplex. If no dealer write direct on 30 Days' Free Trial. Illustrated booklet FREE. Write today.

**AMERICAN IRONING MACHINE COMPANY**  
V26E, Lake Street, Chicago

**The Hudson-Fulton Storage Battery**

CAPACITY: 4 volts, 20 amp. hours.  
2 volts, 40 amp. hours.  
DIMENSIONS: 6 1/2 x 6 1/2 x 10 in. high. Weight 20 lbs.

An ideal battery for operating Christmas Tree Lamps, Electric Fans, or any purpose where a constant and reliable current is required. Rechargeable from Edison circuit or at any automobile charging station at low cost. Price \$5.00. Send for circular.

**The Storage Battery Supply Co.**  
239 East 27th Street, New York  
Mfrs. of Storage Batteries and Accessories of Every Description.

**Electric Lights**

A Complete 8 Light Outfit for \$110

This price includes Dynamo, Storage Battery, Lamps, Wire and Fittings. Can be installed by any one.

The dynamo can be driven by any convenient power, steady or intermittent. Only One-half Horse Power required.

**ELBRIDGE ELECTRICAL MFG. CO.**  
ELBRIDGE, N. Y., U. S. A.

Don't Throw it Away

Does Your Granite Dish or Hot Water Bag Leak?

USE **MENDETS**

They mend all leaks in all utensils—tin, brass, copper, granite, hot water bags, etc. No solder, cement or rivet. Any one can use them; at any surface, two million in use. Send for sample like 10c. Complete pkg. assorted sizes, 25c postpaid. Agents wanted. Collette Mfg. Co., Box 192 Amsterdam, N. Y.

Gas meter, H. Christman	933,150
Gas purifying apparatus, W. McArthur	933,097
Gas scrubber, G. Gray	933,430
Gas storing tank, acetylene, P. C. Avery	933,162
Gases, apparatus for separating mixed, C. J. A. Flouze	933,243
Gases electrically treating, I. Mosicki	933,094
Gate, Sprague & Mulroyan	933,594
Gate, J. E. Smith	933,077
Gearing, W. J. Schoonover	933,672
Glass cutting machine, A. L. Millett	933,481
Glove, mitten or the like, A. G. Hoegen	933,449
Governor speed regulator, the Dion & Bouton	933,367
Grab, safety, W. Remsnyder	933,583
Grading pulverulent materials, apparatus for, S. Cooper	933,532
Grain bin, G. M. Bond	933,617
Gun, breech loading gun actuated, E. N. McClean	933,098
Gun lock, J. Stauber	933,135
Gun sight attachment, H. Korrodi	933,469
Hair comb, J. Swanberg	933,274
Harrow, J. Mattern	933,719
Hat baking oven, C. F. Bennett	933,413
Hat fastening, lady's, Morris & Marks	933,659
Hat holder, T. M. Coleman	933,963
Hats, article holder for, G. Leopold	933,473
Hatch operating mechanism, H. M. Gleason	933,070
Head rest, E. O. Leahy	933,571
Headlight, C. L. Betts	933,614
Heel cushion, pneumatic, W. L. Gordon	933,551
Heel spring, T. Deo	933,422
Hinge, J. H. Kaufman	933,648
Holding mechanism, G. A. Armstrong	933,356
Horse boot, M. Weiss	933,508
Hose nozzle, garden, J. G. Kasjens	933,464
Hose rack, H. Gibbs	933,600
Hot air heater, B. L. Short	933,128
Hydrant, reel operated, W. J. Clay	933,290
Hydrocarbon burner, G. E. Whitney	933,684
Ice shaver, A. M. Treiston	933,520
Ice shaving machine, G. S. Blakeslee	933,154
Ingot mold, automatic stripping, Morie & Magnanelli	933,468
Inhaler, E. Carabias	933,390
Internal combustion rotary engine, W. G. Macomber	933,316
Ironing machine, A. Kreuter	933,256
Ironing table, Fride & Davenport	933,390
Ironing table and sleeve board, combined folding, T. C. Krings	933,568
Jar cap or closure, E. D. Schmitt	933,347
Jars and the like, closure for, A. Schram	933,123
Jars, machine for applying metal caps or closures to, E. D. Schmitt	933,130
Keel, metallic, K. A. Zimmerer	933,520
Kettle safety filling device, tea, G. T. Bohan	933,063
Key, See Telegraph key	
Knife cleaner, P. H. Lechlotte	933,313
Knitted fabric, ribbed, R. W. Scott	933,673
Knitting machine, circular automatic stocking, J. D. Hemphill	933,443
Knotter, cord, J. A. Sharp	933,136
Lacing hook setting machines, spacing mechanism for, W. F. Fraser	933,284
Ladle construction, G. P. Jones	933,732
Lamp, F. A. Curtis	933,162
Lamp, J. R. McKay	933,385
Lamp attachment for vehicles, G. S. Sherman	933,350
Lamp, baker's oven, C. Robson	933,113
Lamp bulbs, locking device for incandescent electric, L. Davie	933,296
Lamp, gas, Humphrey & Wright	933,177
Lamp, incandescent electric, Parkas & Jaeger	933,539
Lamp, inverted, P. B. Johnson	933,734
Lamp, inverted, gas, S. W. Hyatt	933,252
Lamp, inverted incandescent gas, A. J. Hoffmann	933,176
Lamp shade holder, W. V. B. Reiter	933,135
Lamp, means for controlling and controlling vehicle, A. A. Clark	933,694
Lamps, weatherproof socket for electric, G. W. Goodridge	933,644
Lap robe holder, H. P. Tyrell	933,402
Last, Lower, Kittlinger	933,087
Latch, automatic switch, W. S. Weston	933,511
Leaf spring, W. J. Harrison	933,441
Leather and making the same, artificial, L. V. Guilleaume-Chaput	933,645
Lens mounting, W. R. Uhlemann	933,502
Letter and document distributor, F. Bristow	933,156
Lifting saving mattress, H. Schomburg	933,671
Lifting jack, P. L. Gornley	933,705
Lights, head gear for supporting, D. E. Taylor	933,499
Link mesh, W. J. Bailey	933,411
Lintype machine attachment, A. F. Welting	933,569
Liquid selling machine, automatic, A. Meinert	933,478
Liquids from closed receptacles, device for drawing, G. H. Cress-Williams	933,161
Lock and fastener, J. Robertson	933,596
Lock and key for same, A. Goggin	933,703
Locomotives, device for preventing hold-ups on, C. J. Johnson	933,565
Log handling mechanism, C. E. Cleveland	933,231
Logging means, lead block for, S. J. & P. W. Davis	933,533
Loom, H. Le Doux	933,457
Loom pick mechanism, T. Mable	933,403
Loom shuttle, J. Lacroix	933,376
Loom, self replenishing, E. H. Ryan	933,492
Loom, self replenishing, G. B. Ambler	933,613
Looms, speaker for plaid fabric, F. A. Whitmore	933,219
Mail bag pick up mechanism, B. R. Simmons	933,272
Mail clip, J. Klebl	933,311
Malt house, J. F. Dornfeld	933,165
Manure spreader, D. K. Wilson	933,610
Match, duplex, J. Roche	933,293
Match unloading and holder, Stead & Birch	933,466
Mattress supporter, J. Wilkins	933,215
Measuring device, liquid, A. Bruce	933,528
Metal box, F. O. Buschbaum	933,229
Metal cutting tools, rolling mill for, E. J. Poole	933,308
Metal pieces, uniting, C. F. Jacobs	933,459
Metal, treating molten, H. W. Partin	933,576
Metal wheel, A. E. Noble	933,102
Metals or steels of all qualities, metallurgical process to produce, L. H. Baraduc-Muller	933,357
Metallic product, G. F. Allen	933,612
Metallic receptacles, machine for manufacturing, F. Olejnik	933,370
Milk cooler, Lindgren & Mattson	933,652
Milking, device for teaching, P. J. De Vries	933,535
Milking machine, B. Kennedy	933,466
Molding machine, W. E. McCleary	933,485
Mowers, gathering and dropping device for, C. A. Rice	933,391
Multiple effect receiver, G. F. Voortman	933,682
Music leaf turner, A. H. Osterman	933,334
Musical instrument, double scale pneumatic, T. Danquard	933,396
Mute, K. Fujita	933,244
Nursery chair, P. S. Chandler	933,624
Nut device, lock, J. S. Conrad, et al.	933,420
Nut lock, C. Starzman	933,595
Oil burner, B. P. Selsor	933,674
Operating table for osteopathic treatment, W. O. Galbreath	933,170
Ore separating machine, dry, Bonson & McLaughlin	933,053
Ore separating process, M. Rutenburg	933,491
Ore washer and concentrator, A. Dieu	933,632
Ores, treating, Lockwood & Samuel	933,717
Oscillation device, G. W. Pickard	933,263
Package, B. F. G. Linnell	933,189
Packing box or case, D. J. Cable	933,287
Pail holder, milk, Fitch & Chamberlin	933,542
Paint can, L. Henke, Jr.	933,444
Pan handle, dish, C. F. Pfister	933,487
Paper bottle making machine, C. F. Jenkins	933,460
Paper cutting machine, G. M. Farnham	933,540
Paper machine pulp feeding device, R. F. Millard	933,656
Paper stock squeezing rolls, B. R. Wagg	933,604
Paper tube making machine, S. I. Prescott	933,724
Papering machine, J. L. J. Barclay	933,544
Peeling block, D. Atherton	933,521
Pea huller, W. L. Hay	933,559
Peg wood sharpener, G. W. Bowers	933,414
Pen, fountain, T. C. Grant	933,589
Penholder, A. M. Gardner	933,547
Pencil holder, C. Platner	933,353
Pendulum escapement, self-adjusting, W. B. Miller	933,381
Perambulator folding, G. K. K. K.	933,079
Photographic plates or films for different temperatures, apparatus for determining relative times of development of, A. W. King	933,605
Piano, either, H. F. Schmitt	933,670

**Morton R. Edwin Panatelas**

**\$240 per hundred instead of \$500**

By all standards of comparison this is a 10c. cigar. It will satisfy the most cranky smoker of imported brands. It is fully 6 1/2 in. long, strictly hand made, of choicest Havana tobacco—genuine Sumatra wrapper. It smokes freely and evenly—never charrs down the side, but keeps burning coolly and fragrantly to the last tooth-hold.

The reason this cigar is sold at \$2.40 instead of \$5.00 per hundred is because I buy and sell for cash. I ask no credit, neither do I give it. I personally buy my tobacco direct from the grower in Cuba and pay him at least five weeks before the tobacco reaches the U. S. Custom House. I buy for less and sell for less. I believe in what Elbert Hubbard said in April, 1907, issue of the Philistine:

"A Credit Account is the most luscious form of borrowing money. When you don't pay the merchant at once for the goods you buy from him, you are borrowing money from him, and disguised in the price is much more than the legal rate of interest. Better to borrow the actual cash and know how much you have to pay for the accommodation; but it is better still to practice self-denial and go without the thing you want till you have the cash to pay for it."

"All the losses of the merchants who give credit are made good by the people who pay."

"The merchant who gives credit is not in business for his health any more than the pawnbroker is."

Among my 35 different brands I have an "in between" smoke called "Old Fashioned Havana Smokers." I want you to be on smoking terms with them, because they are just the thing you want when you don't want a big cigar. They are Havana filled—4 inches long—blunt at both ends—made the way the Cuban planter rolls tobacco for his own use—without a binder.

I'm so eager to have you try this smoke that I'll send you a sample box of 12 free along with an order for my Panatelas, because you will buy them again.

Send me \$2.40 for 100 Morton R. Edwin Panatelas. Smoke as many as you like—smoke them all if you want to, and if you then tell me that you didn't receive more than you expected, I'll return your money and we'll remain friends.

If you want to know who I am and whether or not I run my business on the square, if you have any doubts as to my making good if my cigars don't, just inquire from any bank or commercial agency about me. If you don't like the report you get, keep your cash at home.

Illustrated price-list sent on request.

**MORTON R. EDWIN**  
Dept. S. A. 64-66 and 67-69  
West 125th St., New York  
Make checks payable to the Edwin Cigar Co.

**Smithmade Admiral Suspenders**

No Strain Comes Upon the Leather Ends They Slide

With Double Reinforced Ends, Metal Bearing and Hook

Button Cast-off

Smithmade Suspender Company  
Boston, Mass.

**BLACKSTONE A BIG PENCIL FOR BIG MEN**

Most pencils are made to sharpen, this one is made to write. Blackstones are for men too busy to fuss. You don't care that we mellow the graphite six months, test every load, case the lead in Florida cedar. This is a pencil that works all day without leaving your hand. Newspaper men use it. Lawyers use it. Ministers swear by it. Business men and business women owe themselves a trial of it. Sample sent for 10c. Stationers sell them.

**A. L. SALOMON & CO., Makers of Aluminoid Pens.**  
345 Broadway, NEW YORK CITY.

Please mention the **SCIENTIFIC AMERICAN** when writing to advertisers





## A Failure at Fifty

Out of a job at fifty—is the fate of the untrained man.

Business requires not only natural ability but special training.

### The Trained Man Can Defy Old Age

The American School of Correspondence can fit you for congenial, well-paid positions in your early years, and make your services valuable in your old age. Training only can compensate for the energy of youth.

For thirteen years the School's *Engineering Courses* have set the standard for thoroughness and practicalness in correspondence instruction. The School has trained thousands of men for the technical professions, or has advanced them to higher positions. To-day these courses represent the highest development of correspondence teaching.

### The Courses in Commerce, Accountancy and Business Administration

set the same high standard in the commercial world. They prepare for the best-paid business positions; they are prepared by practical business men who have "made good" by practicing what they teach; they are planned to meet the needs of both the young man who is just starting in, and the older man who has almost "arrived."

Get your training now, while you have the time and energy for study. Mail the coupon to-day.

American School of Correspondence  
CHICAGO, U. S. A.

#### FREE INFORMATION COUPON

American School of Correspondence:  
Please send me your Bulletin and advise me how I can qualify for position marked "X."

- |                     |                         |
|---------------------|-------------------------|
| Bookkeeper          | Draftsman               |
| Stenographer        | Architect               |
| Accountant          | Civil Engineer          |
| Cost Accountant     | Electrical Engineer     |
| Systematizer        | Mechanical Engineer     |
| Cert'd Public Acc't | Sanitary Engineer       |
| Auditor             | Steam Engineer          |
| Business Manager    | Fire Insurance Engineer |
| Commercial Law      | College Preparatory     |

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
OCCUPATION \_\_\_\_\_  
Scientific American 9-25-09

**THE "BEST" LIGHT**

EVERY one is a self-contained miniature light works. 100 to 200 candle power. Costs less than kerosene.

Absolutely safe  
Very brilliant  
Powerful  
And steady.

Every lamp warranted.  
Over 200 styles.  
Agents wanted. Catalog free. Write to-day.

**The Best Light Co.**  
87 E. 5th St.  
Canton, O.

**MAKES AND BURNS ITS OWN GAS.**

## Government Homesteads

Over one and one half million acres of land open for settlement in Cheyenne River and Standing Rock Indian Reservations, October 4th to 23rd.

Registration at Pierre and Aberdeen, S. D.

Direct route to registration points is the Chicago & North Western Ry.  
Special low homeseekers' round trip rates.

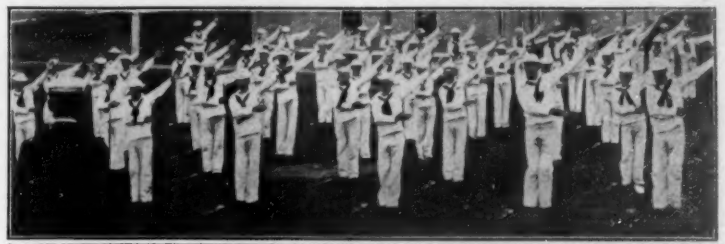
This land is well watered by the Cannon Ball, Grand, Moreau and Cheyenne Rivers and their tributaries. The soil is a light loam, fertile and makes a good grain producing land. The land must be lived on and improved. A low valuation of from 50 cents to \$6.00 per acre has been placed on the land by the Government, arranged in easy annual payments covering a period of five years.



The C. & N. W. Ry. prints a descriptive pamphlet, telling how to secure a homestead on the day from the Government. Free copies on application.

W. B. KNISKERN  
Passenger Traffic Mgr.,  
C. & N. W. Ry.,  
Chicago, Ill.

Steel, manufacture of, G. J. Stock	933,596
Steel tie, O. L. Robert	933,592
Step or platform attachment, L. A. Wilson	933,148
Stereotype casting box, S. G. Goss	933,172
Stitch making machine, imitation, J. B. Hadaway	933,174
Stitch separating and indenting machine, J. B. Hadaway	933,175
Stony or earthy materials, apparatus for the treatment of, H. E. Kussager	933,669
Stoves, electric lighter for gas, R. Hofmeister	933,450
Stuffing box, G. Strance, et al.	933,400
Suit, girl's combination, S. H. Burket	933,286
Swaging tool, R. Schuebel	933,588
Switch, F. McKnight	933,100
Switchboard, R. C. Livingston	933,716
Swivel, W. R. Clarkson	933,625
Syringe, C. Stahl	933,398
Syringe, C. Remhof	933,490
Syringe nozzle, J. W. Perkins	933,578
Talking machine, H. F. Cook	933,234
Tank device, widow's-craze, P. W. Morris	933,484
Telegraph key, Smith & Conkling	933,726
Telegraph or cable code, M. L. Sweeney	933,679
Telephone apparatus, Turner & Hoff	933,404
Telephone attachment, J. B. Buckholder	933,223
Telephone supervisory system, W. S. Pace	933,335
Telephone system, C. S. Winston	933,150
Telephone trunking system, C. S. Winston	933,149
Telephones, memorandum attachment for, G. M. Urle	933,277
Telpher system, B. T. Hitch	933,564
Temperature controlling device, W. B. D. Penman	933,577
Thill coupling, antirattling, N. Burdall	933,691
Ticket and card case, V. H. Pollock	933,662
The plate, W. L. De Remer	933,164
The plate and rail antireefer, combined, B. R. Scott	933,122
Tie plate washer, J. W. Kendrick	933,122
Timepiece, solar, H. Hansen	933,556
Tire for automobiles and other vehicles, pneumatic, C. A. Lewis	933,715
Tire remover and replacer, H. M. Owens	933,106
Tire tread, C. L. Rempes	933,110
Tobacco pipe, A. E. Mather	933,081
Tobacco pipe, J. C. Drucklieb	933,240
Tobacco pipe, J. N. Courtney	933,628
Tobacco spearing machine, H. Shinn	933,127
Tobacco stemming machine, W. D. Doremus	933,365
Toggle lever flask hinger, B. N. Touchman	933,405
Tollet, G. J. Burkhardt	933,619
Tollet composition, J. C. Sherman	933,395
Tool, combination, G. H. Waters	933,278
Tool, compound, G. T. Hastings	933,442
Tool coupling, pneumatic, A. Hebert	933,561
Top, self-spinning, O. E. Frear	933,544
Torpedo, gas propelled, I. N. Lewis	933,556
Tower, transmission, D. R. Scholer	933,452
Toy, mechanical, R. E. Cecil	933,623
Track hanger, elevated, H. R. Callander	933,416
Traction and lawn rolling roller, H. T. Coldwell	933,292
Train door fastening, freight, M. C. Devine	933,632
Train stop and signal, automatic, W. H. Harris	933,440
Trap, See Steam trap	
Tray, letter, W. W. Worcester	933,517
Tree and plant guard and protector, W. Lipplacott	933,454
Tree protector, W. H. Mohr	933,453
Tree, adjustable and collapsible, A. H. Kramer	933,659
Trolley, J. Ledwinka	933,084
Trolley base, F. Volk	933,506
Trolley pole, S. Speer	933,208
Trough rack, feeding, W. A. McCollough	933,384
Truck, car, J. C. Barber	933,223
Truck, car, H. F. Pope	933,579
Truck, incline, C. E. M. Miller	933,321
Truck, piano, S. Bilger	933,616
Turbine, elastic fluid, W. J. Cartwright	933,483
Turbine, internal combustion, M. St. Clair	933,355
Turbines, vane ring for, B. Ljungstrom	933,379
Turn table turner, R. B. Farrell	933,637
Typewriter, S. Snell	933,593
Typewriter machine, J. H. Barr	933,048
Typewriter machine, H. H. Steele	933,209
Typewriter machine, O. Woodward	933,219
Typewriter machine calculating attachment, F. J. Tillman	933,600
Typewriter machine ribbon mechanism, O. C. Kovie	933,181
Typewriter machine ribbon mechanism, E. G. Latta	933,186
Typographic machine, B. A. Brooks	933,652
Valve, G. L. Crook	933,698
Valve, alarm, R. Grinnell	933,173
Valve, alarm, C. Melton	933,192
Valve, automatically controlled gas, G. M. Bierly	933,153
Valve, cylinder relief, C. P. White	933,147
Valve, equilibrium stop, J. Koenig	933,148
Valve, quick acting radiator, E. P. Allen	933,222
Valve, radiator, G. M. Bard	933,225
Vehicle brake, B. F. Trice	933,680
Vehicle wheel, Beall & Skeelenger	933,040
Vehicle wheel, S. W. Higgins	933,708
Ventilator, L. Silberman	933,271
Ventilator, S. L. Morse	933,383
Voting machine, endorsing device, W. J. Lausterer	933,377
Voting machine endorsing device, A. J. Gillespie	933,428
Voting machine interlocking mechanism, F. Kelper	933,372
Voting machine key operating and locking bar, W. J. Lausterer	933,378
Voting machine lock-out, A. J. Gillespie	933,427
Wagon timing device, E. F. Chandler	933,418
Wardrobe, cupboard, or the like, folding, A. Ulton	933,210
Washboard, self-washing, E. M. Gerdon	933,541
Washing machine, E. Beebe	933,050
Washing machine, P. P. Kiel	933,183
Washing machine, H. W. Darrow	933,295
Washing machine, S. Hartmann	933,309
Washing machine, H. W. Scott	933,348
Washing machine, S. V. Brammer	933,618
Washing machine attachment, F. L. Bartlett	933,358
Washing machine gearing, H. Cammack	933,492
Waste trap, L. Welch	933,279
Watch, repeating, T. A. & J. B. Connolly	933,696
Water softener, Bain & Smith	933,047
Water tube boiler, vertical, E. C. Fisher	933,541
Watering tank, A. N. Estabrook	933,064
Weatherproof composition, H. Gallowsky	933,171
Weeder, C. F. Billan	933,227
Weeding and transplanting implement, hand, H. L. Hughes	933,304
Weighting device, Q. B. Wright	933,608
Welding and bonding rails and other metal pieces, C. F. Jacobs	933,456
Wheel, See Metal wheel	
Whip socket, A. R. Tuttle	933,140
Whips or like articles, case for, N. F. Alston	933,044
Wind shield, J. H. Sprague	933,496
Wind wheel, H. Schmitt	933,294
Window machine, thread, M. Metz	933,092
Window screen, roller, Gibson & Beveler	933,245
Window shelf, F. H. Guekow	933,643
Window ventilator, W. H. Dean	933,421
Wire coiling and weaving machine, M. B. Lloyd	933,476
Wire fabric, interlocking hook for, B. Smith	933,130
Wire frame, making, G. K. Rix	933,475
Wire coloring, W. A. Hall	933,342
Wood, coloring or transforming, W. A. Hall	933,436
Wood, transforming, W. A. Hall	933,437
Wrench, T. H. Munro	933,096
Wrench, T. H. Munro	933,096
Yarn or thread into carriers, machine or mechanism for drawing, Whitmore & Dougherty	933,214
Zinc ores, treating, F. T. Snyder	933,133



## The Making of Men

The reasons given by most men for desiring to enter the Navy are: "To see something of the world"; "to learn a trade"; "to save money"; and—"To make a man of myself."

It is becoming more generally known that the Navy offers a steady, ambitious young man as good opportunities for a future career as he can obtain anywhere. When bluejackets are questioned regarding their opinion of the Navy after a few years' service, their most frequent answer is, "It made a man of me."

Navy training develops character. Under the Navy system of advancement, the worthy young man's progress is assured. He is given greater responsibility, with higher pay, as his capabilities increase. Inevitably he develops self-reliance; becomes quick and alert, resourceful and confident, with a military bearing and a clear brain—the natural accompaniment of a healthy life and a clean body. If the young man does not develop under Naval influences he lacks the qualities to "make good" anywhere.

But Navy training alone would not produce this result. The young man must come into the Navy with good principles, industrious, of temperate habits, a common school education, and a serious intention to stick to his job, whether he likes it at first or not. This is the type of youth the Navy appeals to, and shiftless characters need not apply.

Look for the address of the Navy Recruiting Office in the want columns of your Sunday papers. If you don't find it, write for illustrated Booklet describing duties, pay, privileges, etc., and for instructions how and where to apply. Address

Box 39, BUREAU OF NAVIGATION  
Navy Department Washington, D. C.

### INVENTORS

We manufacture all kinds of Machine Novelties. Consult us as to developing, perfecting and marketing your patents.  
MACHINE ACCESSORIES AND NOVELTIES MFG. CO.  
PROVIDENCE, R. I.

### CONSULTING ENGINEER.

ERNEST L. HANSOME  
Reinforced Concrete  
11 Broadway, New York

**SOUTHERN STAMPING & MFG. CO.**  
Manufacturers of special and patented articles.  
R. S., Nashville, Tenn.

**REBUILT TYPEWRITERS**  
All Makes. All Prices. Quality Unsurpassed  
Send for booklet  
American Writing Machine Co., 245 Broadway, N. Y.

**ICE MACHINES** Corliss Engines, Brewers and Bottlers Machinery. THE VILKIN MFG. CO., 609 Clinton St., Milwaukee, Wis.

**MODELS & EXPERIMENTAL WORK.** Inventions developed. Special Machinery. E. V. BAILLARD CO., 24 Franklin Street, New York.

**RUBBER** Expert Manufacturers Fine Jobbing Work. PARKER, STEARNS & CO., 288-290 Sheffield Av., B'klyn, N. Y.

**MODELS & EXPERIMENTAL WORK** Anything from a Watch to an Automobile. Chas. E. Dressler & Co., Metropolitan Bldg., 1 Madison Ave., New York

**DIE MODELS SPECIAL WORK TOOLS MACHINERY** NATIONAL STAMPING AND ELECTRIC WORKS 153-159 S. Jefferson Street, Chicago, Ill.

**MODELS & EXPERIMENTAL WORK,** Gears, Dies, Tools, Novelties manufactured. M. P. SCHELL, 1759 Union Street, San Francisco

**HOEFT & COMPANY** Die Makers, Model Makers, Machinery Builders, Punch Presses, Light and Heavy Stampings. 1-9 Sticksen St., Chicago, Ill., U.S.A.

**New York Model and Experimental Works** INVENTIONS DEVELOPED. SPECIAL MACHINERY 442 East 166th Street New York, N. Y.

**DRYING MACHINES** For Granular Materials S. E. WORRELL Hazlet, Mo., U. S. A.

**INVENTORS, MANUFACTURERS, SPECIAL TOOLS, SPECIAL MACHINERY, METAL SPECIALTIES, METAL NOVELTIES**

**INVENTORS** We manufacture METAL SPECIALTIES of all kinds, to order; largest equipment; lowest prices. Send perfect sample for low estimate and best expert advice. **FREE** THE EAGLE TOOL CO., Dept. A, Cincinnati, O.

### Talking Without Wires

NO WIRES, NO POLES, NO FRANCHISES

### The Collins Wireless Telephone

The Collins Wireless Telephone Company is established on a solid basis and has a well equipped laboratory and factory, always open to visitors. The Company has no debts, no bonds and no preferred stock.

You may have missed the Bell, the Phonograph or Electric Light. Don't miss the Collins. **Come to our office and talk without wires.**

Write immediately for free booklet: "Story of the Wireless Telephone", or call and investigate for yourself by actually talking without wires over the Collins Wireless Telephone and discern its value. You want to consider its wonderful possibilities.

The Collins Wireless Telephone Co. 54-56 Clinton Street, Newark, N. J.

## WELL DRILLING MACHINES

Over 70 sizes and styles, for drilling either deep or shallow wells in any kind of soil or rock. Mounted on wheels or on skids. With engines or horse power. Strong, simple and durable. Any mechanic can operate them easily. Send for catalog.

WILLIAMS BROS., Ithaca, N. Y.

### Learn Watchmaking

We teach it thoroughly in as many months as it formerly took years. Does away with tedious apprenticeship. Money earned while studying. Positions secured. Easy terms. Send for catalog.

ST. LOUIS WATCHMAKING SCHOOL, St. Louis, Mo.


**NOVELTIES & PATENTED ARTICLES** MANUFACTURED BY CONTRACT. PUNCHING DIES, SPECIAL MACHINERY, E. KNOX SLOW STAMPING & TOOL WORKS, CLEVELAND, O.

Are you interested in Patents, Model or Experimental work? Our booklet entitled

**WHAT WE DO—HOW WE DO IT** will be sent to you on request. KNOCKHOCKER MACHINE WORKS, Inc., 8-10-12 Jones Street, New York

**The Ball Transmission** for Automobiles & Motor Boats NEW YORK GEAR WORKS





**"INFALLIBLE"**

**SMOKELESS**

The only **DENSE** powder  
made in America

**WATERPROOF  
ABSOLUTELY**

Always the same under  
all conditions. Not affected  
by heat or moisture. As  
good ten years hence as  
today.

Any dealer can supply  
you with shells loaded with

**"INFALLIBLE"  
SMOKELESS**

Send 12 cents in stamps for a set of six  
pictures illustrating "A Day's Hunt."  
Address Dept. 2.

**E. I. DU PONT DE NEMOURS  
POWDER CO.**  
Wilmington, Del., U. S. A.



**\$3.50 A Backus  
Water Motor**

For Polishing, Grinding,  
and Power

Can be screwed on any faucet

**BACKUS WATER MOTOR CO., Newark, N. J.**

**LEARN TO BE A WATCHMAKER**  
Bradley Polytechnic Institute  
Peoria, Illinois  
Formerly Peoria Technical Institute  
Largest and Best Watch School  
in America

We teach Watch Work, Jewelry,  
Engraving, Clock Work, Optics,  
Tooling, Finishing, Repairing, and  
many other subjects at moderate prices.  
Send for Catalog of Information.



**10 DAYS FREE TRIAL**

We ship on approval, without a cent  
deposit, freight prepaid. **DON'T  
PAY A CENT** if you are not satisfied  
after using the bicycle 10 days.

**DO NOT BUY** a bicycle or a pair  
at any price until you receive our latest  
art catalog illustrating every kind of  
bicycle, and have learned our unheard of  
prices and marvelous new offers.

**ONE CENT** is all it will cost you to  
thing will be sent you free postpaid by  
return mail. You will get much valuable in-  
formation. Do not wait, write it now.

**THREE, Coaster-Brakes, Hub-  
bumps and all sundries at half priced prices.**

**MEAD OYLE CO., Dept. 7, 125 CHICAGO**

**Crescent  
Wood Working  
Machinery**

Strong—Substantial—Durable—  
Easy Running

Band Saws, Saw Tables, Jointers,  
Shapers, Boreers, Ring Molds, Disk  
Grinders, Planers, Flanes and  
Machines, Band Saw Blades.

Catalog sent on application

**THE CRESCENT MACHINE CO.**  
280 Main St.  
Easton, Ohio, U. S. A.

**WE WILL MAKE** your models  
and give you estimates on  
manufacture of any metal novelty. Automatic ma-  
chinery, tools, dies and expert work our specialty.

**AUTOMATIC HOOK & EYE CO., Hoboken, N. J.**

## RUNDEL AUTOMATIC STROPPER

Keeps a Perfect Edge  
On Any Safety Blade

A child can work it. Just push and pull the  
stropper up and down the strop. Blade is held at  
correct angle and reverses automatically—can't cut  
the strop. Then you always have sharp blades  
without buying new ones. Very economical and  
convenient—no safety razor complete without it.

Sold on Approval By All Dealers

Try one for 10 days. If you don't wish to keep it,  
your money is promptly returned. Complete out-  
fit consists of a **Stropper**, strongly built of brass and  
steel, nicely nickel plated, and with rubberoid finish  
handle; **Three Blade Holders**; and a 24-inch finest  
quality **Horsehide Strop**. All are enclosed in a hand-  
some case, and sell everywhere for \$3.00. If your  
dealer can't supply you, we will send the outfit  
prepaid.

**Rundel Automatic Stropper** costs more than its imi-  
tations, but it is the only stropper adapted to all  
style blades; the only stropper scientifically ad-  
justed and controlled; the only stropper that au-  
tomatically stropps exactly "like the barber"; the  
only stropper that's made right, works right, and  
will last for years.

**Free Book on Art of Correct Shaving** Tell us the name of a dealer that sells razors,  
and we will send free "Hints for Shavers"—  
a valuable book just written by an expert barber. Send for it to-day.

**RUNDEL MFG. CO. 187 Main Street ROCHESTER, N. Y.**



## "ANTI-CORROSIVE CYLINDER OIL"



Established  
FIFTY-ONE  
years ago.

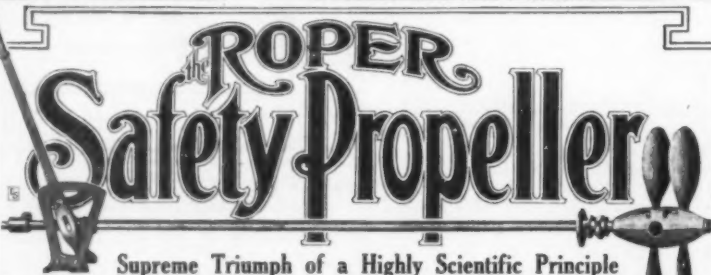
was not used on the  
**CLERMONT.**

But is now used on the  
**FASTEST STEAMSHIP IN THE WORLD**

with reciprocating engines.

**E. H. KELLOGG & CO.**

NEW YORK LIVERPOOL LONDON



**Supreme Triumph of a Highly Scientific Principle**

Two sets of blades so arranged as to give **Absolute and Instantaneous Speed Control in Either Direction, Entirely Without Throttle or Spark Adjustment**, once the motor has been started. **No Engine Racing, Load Maintained Constant** at any speed or at full stop. **One easy throw of the lever and the Full Power of the Motor always Available.** **Strong, Durable, Practical, Positive in Action.** **No gears or clutches, every action direct and immediate.** **Thirty Days' Free Trial on Your Own Boat.** Write for Catalog and details. **C. F. ROPER & CO., Hopedale, Mass.**

## FOR 148 YEARS A. W. FABER has made the highest grade of lead pencils

**"CASTELL" PENCILS**

DRAWING  
COPYING  
INK

represent that acme of perfection that can be obtained only by experience and long effort to produce  
the finest it is possible to manufacture.

Sold by all stationers and dealers in artists' and drawing materials. Samples worth double the money will be sent you on receipt of 10c.

**A. W. FABER, 49 Dickerson Street, Newark, N. J.**

## \$54.00 per day The Record CAMERA-SCOPE

And we can prove it. Anyone can operate it. Makes finished button photographs a minute. Price of Camera-Scope, with supplies for making 30 pictures (enough to pay for the complete outfit) **\$25.00**. Extra buttons \$1 per hundred; extra frames \$1.50 per gross. Be independent and make money for yourself. Write today.

**W. S. MOUNTFORD, 100 Maiden Lane, New York, N. Y.**

## A HANDY LITTLE TOOL

is our Rule Clamp No. 239  
used to clamp two steel rules  
together—and to end—in ex-  
tension. Rules may be of  
same or different widths up to  
14 inches. Of special value to  
mechanics having tool chests  
smaller than 12 inches.

Price 50c. a pair

Send for 322 page catalog No. 15-B.

**THE L. S. STARRETT CO., Athol, Mass., U. S. A.**

## We Want To Tell You How

You can **save** not only the dealer's profits but his ex-  
cessive charges for installation and repairs by dealing direct  
with the manufacturers. You can keep in your own  
pocket at least one-third the retail price of a heating  
plant. Let us tell you all about the


## Jahant Down Draft Furnace

**Only \$10 down and \$10 per month**, with freight prepaid  
east of the Mississippi River. This wonderful furnace has proven its superiority above all others  
during the last 30 years. It is without doubt the very best heating system for your home. It **saves**  
from 15 to 25 per cent in fuel bills, because the patented "down-draft" burns hard or soft coal—wood or li-  
gnum—without clinders or cinders, giving full heating value of every particle of fuel. Needs less  
attention than any furnace you ever saw. A strong "Guaranty Bond" goes with every Jahant, which  
allows you a **300 days free use of the furnace**. You run no risk, as we supply special  
plans, full directions and give **free all necessary tools**, so that any man who can drive a  
nail can successfully install a Jahant. No matter what make or system of heating you are consider-  
ing, let us tell you more about the many conveniences and good points of our furnace; it's economy.  
It's healthfulness and how you can save money. **Write today for our book.**

**Jahant Heating Co., 90 Howard St., Akron, O.**

We Put  
Every Cent  
of the Dealers  
Profits into Your  
Pocket

## COLD GALVANIZING. AMERICAN PROCESS. NO ROYALTIES. SAMPLES AND INFORMATION ON APPLICATION



**NICKEL**  
AND  
**Electro-Plating**  
Apparatus and Material  
Hanson & VanWinkle  
Co.,  
Newark, N. J.  
28 & 30 S. Canal St.  
Chicago.

## SLEEP OUT- DOORS

We want to show you how thoroughly prac-  
tical it is to receive all the benefits of out-of-  
door sleeping—with the face, only, coming in  
contact with the crisp, out-door air—enjoying  
the comforts of a warm room, protected from  
drafts, storms, colds and insects—by using a

## Walsh Window Tent

Has an awning to protect sleeper—no nails or  
screws to mar the woodwork—can be instantly  
adjusted to any window. Write today for free  
booklet, "What Fresh Air Will Do," and full  
particulars of our 30-day free trial offer.

Recommended by Eminent Physicians Everywhere.

Cabinet Mfg. Co., 305 Maine St., Quincy, Ill.  
Manufacturers of Superior Cabinets for Turkish and Vapor Baths

## THE REASON WHY THE KREMENTZ

**Roller Plate  
Collar Buttons  
Outwear all  
Others**

THIS DIAGRAM ILLUSTRATES  
QUANTITY OF GOLD IN THE  
IMITATION BUTTONS

THIS ILLUSTRATES QUANTITY  
OF GOLD IN THE  
KREMENTZ BUTTON

At all dealers. Gold and rolled plate. Insist on the  
Krementz. If damaged in any way a new one free.  
Story of Collar Button showing shapes and sizes free.  
If dealer will not supply, we will.

**Krementz & Co., 77 Chestnut St., Newark, N. J.**

## McIntyre Guaranteed Sure- Service

**Always-Ready**  
Motor buggies and wagons  
have proved their positive  
worth as pleasure  
vehicles and as  
money-saving  
work vehicles  
for thousands  
in every part  
of the civilized  
world.

**Why Not For You?**

**McIntyre**  
Motor Vehicles

never full—never get tired—cost no more than a good horse and buggy  
—and the time to keep—do more work in less time than three horses.  
Take you anywhere and back again over any kind of road, in all  
kinds of weather. Run 20  
miles on one gallon of  
gasoline. Simple, dur-  
able, economical  
construction. Solid  
tires—no tire  
trouble or re-  
pairs expense.  
For Free Catalog  
Send No. 10 address  
nearest office.

**W. H. McIntyre Co., Auburn, Indiana**

255 Broadway, New York; 110 Grand Ave., Boston City; 410 Third  
Ave. N., Minneapolis; Tenth McIntyre Co., Orem, Utah.

**Model 509,  
12-H.-P., \$450**

## Bristol's Patent Steel Belt Lacing

The Perfect Fastener for all  
kinds of  
Belts

Write for  
Catalogs  
**READY TO APPLY**  
**THE BRISTOL COMPANY**  
**FINISHED JOINT**  
Waterbury, Conn.

Send for  
Bulletin  
1557

## Holtzer-Cabot Magnetos

**Insure Perfect Ignition**  
Heavy shafts—double brush  
rigging—automatic lubrication—  
powerful magnets—  
high efficiency.

**THE HOLTZER-CABOT  
ELECTRIC CO.**  
Boston (Brookline), Mass.  
Chicago, Ill.

## LUFKIN TAPES AND RULES

ARE THE BEST.  
For sale everywhere. Send for  
Catalog No. 16.

**LUFKIN RULE CO.**  
Saginaw, Mich., U. S. A.

New York and London.

## HELMET OIL

**LUBRICATES AND  
PROTECTS**  
ANYTHING  
15-21 S. CLINTON ST.  
**C. H. BERRY & CO. CHICAGO, ILL.**



# SCIENTIFIC INSTRUMENTS



## ENGINEERS

Civil, Mining and Hydraulic

Catalogue "G"

## PROFESSORS

of Physics and Electrical Engineering

Catalogue "P"

## INSPECTORS

of Weights and Measures

Catalogue "S"

Catalogues on request

**W. & L. E. GURLEY**  
TROY, N. Y.

Branch Factory; MANUFACTURERS' EXCHANGE BUILDING, SEATTLE, WASH.

## Pennsylvania Railroad

### BULLETIN

#### A Century of Transportation

Better a hundred years of progress than a cycle of decay. It is not a far cry from the Clermont to the Mauretania as time flies, but every year has been a period of achievement. The world has been up-ended in every field of endeavor. In the particular one of transportation, with the Mauretania type on sea and the "Pennsylvania Special" type on land a century ends with what seems little short of perfection in the science of safe and swift transportation.

Robert Fulton's first ferryboat required nineteen minutes to cross to New Jersey; now it is done in three minutes by a motive power unknown then.

A century ago it required eighteen days to reach Fort Dearborn. Now the "Pennsylvania Special" covers the distance in as many hours.

As a medium of transportation the "Pennsylvania Special" typifies the advance made in the latter half of this period. The locomotive that draws it is the lineal descendant of the "John Bull"; its equipment the ripe development of the "chicken coop" boxes of the "John Bull" train; the 100 pound steel rail over which it speeds is the evolution of the strap rail of the early nineteenth century.

Every department of science has been busy in these creative years to mould into being a perfect means of transportation, and the result is the "Pennsylvania Special."

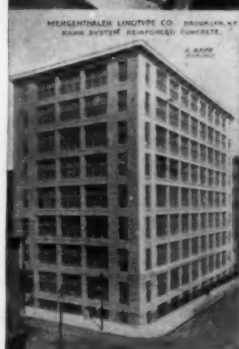
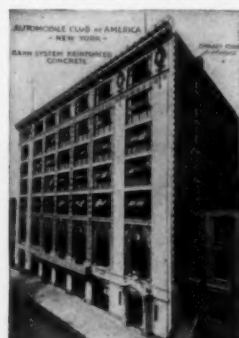
The "Pennsylvania Special" leaves New York every day at 3:55 P. M. and reaches Chicago 18 hours afterwards at 8:55 A. M. Eastward it leaves Chicago at 2:45 P. M. and reaches New York at 9:45 A. M.

For four years it arrived at both terminals exactly on schedule time 83 times out of a possible one hundred.

It is the train for the man whose time is precious.

## When your building burns —your business stops—

Can you afford to build that Factory, Warehouse, Store, Hotel or Residence with wood that burns and rots?



Can fire insurance repay you for destroyed records, unfilled orders, and lost business?

Why not put up a **permanent fireproof** building and save insurance and expense of continual repairs?

The cost is very low if you adopt the **Kahn System Reinforced Concrete**. You save 20% to 30% over the cost of steel frame buildings with fireproof floors. We can prove to you that **Kahn System Reinforced Concrete** is more economical than quick-burning construction.

Over 3,000 important **Kahn System** Buildings in all parts of the world mark the practical endorsement of leading architects and builders. The U. S. Government and world-renowned companies like the Libby, McNeil & Libby Co., Ford Motor Co., Bemis Bag Co., Burroughs Adding Machine Co., have investigated and built **Kahn System**.

The **Kahn System** brings to reinforced concrete an organized building experience and the direct personal service of skilled engineers.

**Kahn System** Economy and **Kahn System** Results are only made possible by use of

## Kahn System Products

**Kahn Trussed Bars:** The perfect reinforcement for concrete beams, girders and joists.

**Rib-Metal:** The ideal reinforcement for concrete floors, roofs, walls and conduits.

**Hy-Rib:** For sidings, roofs, partitions and ceilings. Makes centering and studs unnecessary.

**Rib-Lath:** The stiffest steel lath for plaster, ornamental and stucco work of all kinds.

**Trus-Con Products** for waterproofing and finishing exposed concrete work.

Our large Engineering Department will show you how to use these products advantageously in your particular work.

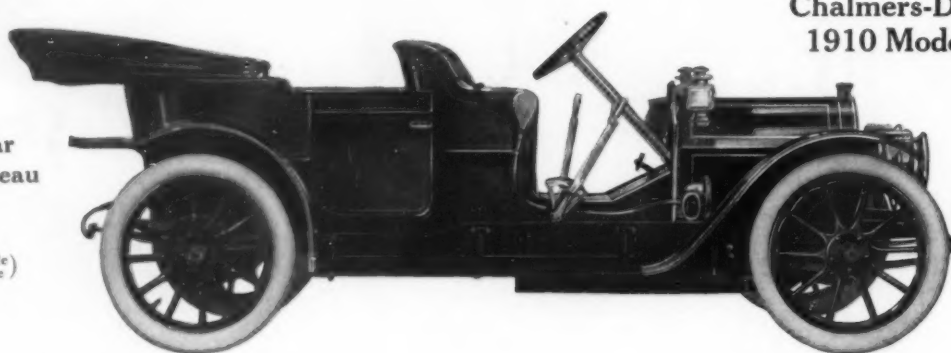
Write us about your building and we will send you special catalog and valuable information free.

"Unburnable Buildings are Best"

**TRUSSED CONCRETE STEEL COMPANY**  
OFFICES IN ALL PRINCIPAL CITIES 502 Trussed Concrete Bldg., DETROIT

**KAHN SYSTEM**

Made as  
Touring Car  
Pony Tonneau  
Roadster  
Limousine  
Coupe (Inside  
Drive)  
Landaulet



Chalmers-Detroit "30"  
1910 Model—\$1500

## Note How Much We Now Give For the Money

In June, 1908, when our "30" came out, it was generally said that we would not for long give such a car for the money.

We half thought so ourselves. Materials then were exceedingly low—far lower than now. And we feared their advance would compel our advance, for our profit was but nine per cent.

But you buyers took our whole output—2,500 cars. And you left us, at the end of the season, with unfilled orders for \$1,200,000.

So we built a new factory, and increased our capacity to 4,000 cars—our output for 1910. And this whole output, by the way, was contracted by dealers before the first car was delivered.

### The Cut in Cost

This new model involved no mechanical changes, so the tools of last year would serve. That meant a heavy saving.

The 1,500 extra cars would involve no added fixed expense.

When we divided out cost by 4,000, instead of 2,500 as last year, we found the cost per car greatly lessened. Then we figured what to do with the saving.

There is no way to improve the mechanical features. They were perfect last year, as thousands of owners know.

So we increased the wheel base to 115 inches. We increased the wheels to 34 inches. We added a little more power.

We made the tonneau more roomy, and the hood correspondingly longer and higher. We gave to the car its present beautiful lines.

We put every cent of our saving into beauty, size and room. Our profit remains nine per cent.

So this is the "30" you get this season for the same price—\$1500.

### Saving on Extras

Then we decided to sell our extras on a profit as small as our cars.

This season we fit our "30" with a Bosch magneto, a Prest-O-Lite gas tank, and two Atwood-Castle new style gas lamps—all for \$100 extra. These extras at regular prices would cost \$175.

We will fit our "30" with a Lenox mohair top—a \$125 top—for \$75.

So this 1910 model, when fully equipped, costs less than the car of last year.

### Reasons for Success

The story of the Chalmers-Detroit "30" is like a tale from Arabian Nights.

Think of outselling our mammoth output the first season by more than 800 cars.

Think of a car which, from its inception, took the topmost place in its class.

The reasons are these:

The car was Mr. Coffin's creation. He spent two years in designing it—made two trips to Europe. And every man in motordom knows that Mr. Coffin's designs are successful.

The car was sold by us on a margin of nine per cent, so it was utterly impossible for any rival to give any more for the money.

The car made endurance records, early in the year, such as no other car at any price ever equaled.

It made a long-distance speed record exceeding 55 miles per hour.

It made that famous path-finding trip between Denver and Mexico City, plowing its way through oceans of sand.

Then it won the Indiana Trophy—the greatest event of the year. One of our stock cars won

the cup, though every rival, save one, sold at a higher price.

### Cost of Upkeep

The popularity of our "30" is largely due to its amazing low cost of upkeep. One of these cars, in a New York Economy Test, went 25.7 miles on one gallon of gasoline.

For the year ending June 1, owners paid us for repairs exactly \$2.44 per car.

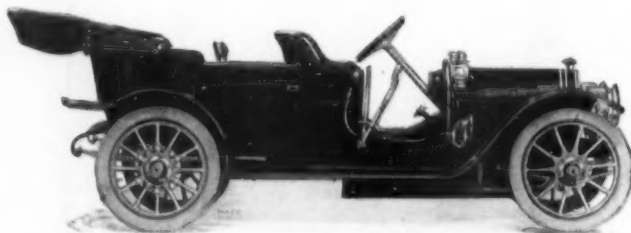
Motor car owners who have learned by experience now seek the car with such records for upkeep.

### All Models Ready Now

Our 1910 models are now on the market. To get one now means several months' use before 1910 begins.

And it is also getting the car that you want. For this season, like last season, there are bound to be hundreds of the disappointed.

Please send now for our catalog showing every new style and feature.



Chalmers-Detroit "Forty"—1910 Model—\$2,750

Made as Touring Car, Pony Tonneau, Roadster

Our 1910 "Forty" has a 122-inch wheel base—ten inches longer than last year. It becomes a 7-passenger car. The wheels are now 36 inches. The upholstery is hand-buffed leather.

We fit our "Forty" with a Bosch magneto, gas tank and gas lamps free. We will fit it with a \$150 mohair top—the best top we can buy—for \$125. The two extra seats, if wanted, cost but \$75 extra.

This car has a four years' record such as no other car ever had.

It has won more important events—in hill-climbing, reliability and speed—than any car at any price.

Now we have given it lines which no car can excel. We have brought it to 7-passenger size. We have given it all the power that any service

requires. We have made it as beautiful as a car can be made.

If you can think of a reason for paying more than this price, we can prove that the reason is wrong. No car at any price goes farther than this, save in higher cost of upkeep.

When you write for our catalog, we will tell you what neighbors own our "Forty". Please judge it by what they say.

Send us this coupon now.

Chalmers-Detroit Motor Co.

Detroit, Mich.

Mail your 1910 Catalog to

Scientific American—New York

**Chalmers-Detroit Motor Company, Detroit, Mich.**  
Members Association of Licensed Automobile Manufacturers U. S. A.